Estimating plant diversity using airborne and SBG-type data in naturally-assembled grasslands

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[80NSSC21K0941]


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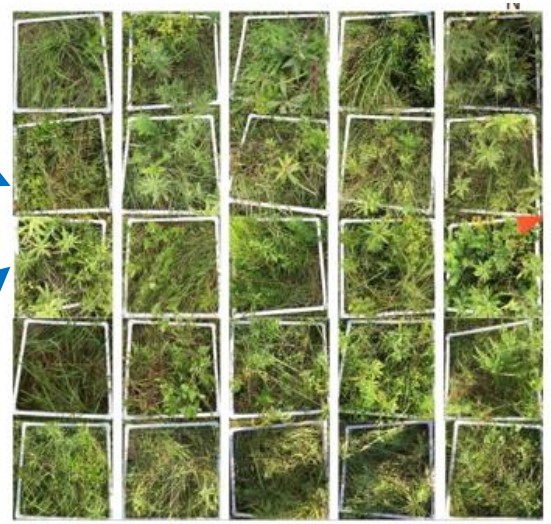
Remote sensing of biodiversity in grasslands: Management practices

~ 4 months after fire

30 months after fire



Blackfeet Burning Crow Buffalo Range, Charles M. Russell, 1905

"Setting part of the Preserve on fire is not arson. It is a scientifically informed effort to bring the wisdom of the past into the present. What happened on the Preserve is a re-creation, an attempt to bring back this grassland remnant to what it once was. Fire is the *red buffalo*."

Visions of the Tallgrass by James P. Ronda, Harvey Payne, Geoffrey Standing Bear

Two objectives

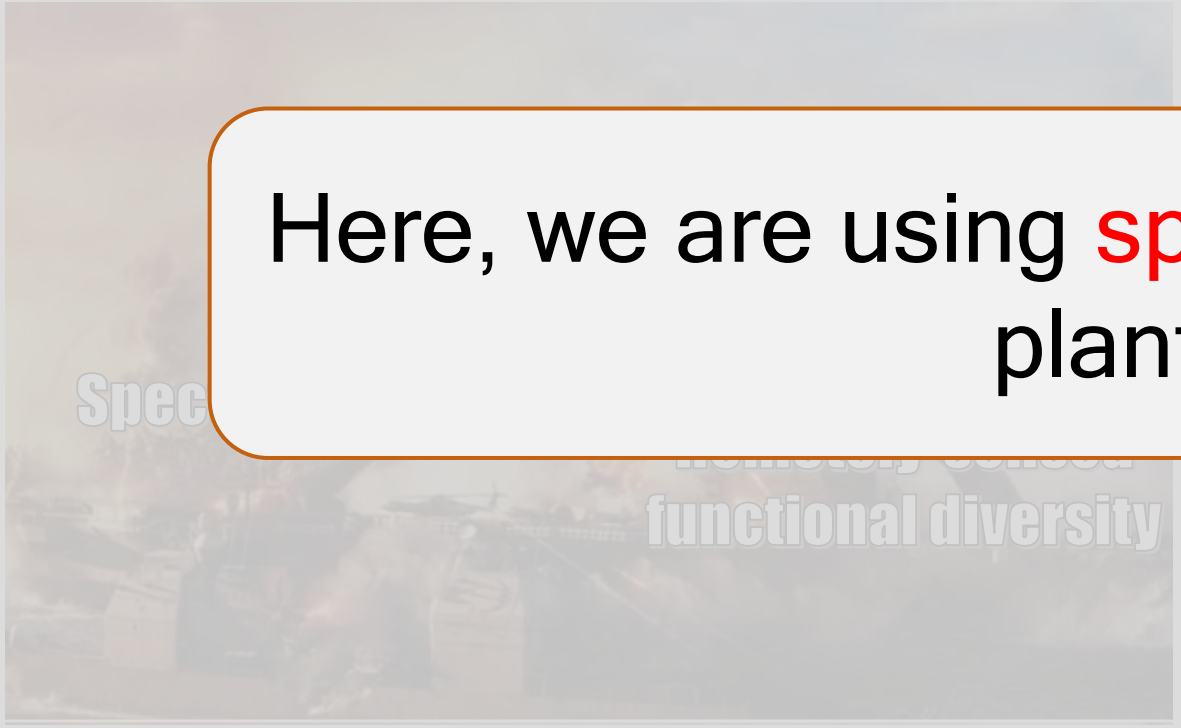
Assess whether imaging spectroscopy (airborne and SBG-like spaceborne) can estimate plant diversity in naturally-assembled grasslands

If so, determine what aspects of plant diversity we are capturing remotely

How to estimate plant diversity remotely?

Figure: Cavender-Bares et al. (2017)

Spectral information (or variation in spectral information) is related to different dimensions of biodiversity



Here, we are using spectral diversity to estimate plant diversity

What aspects of plant diversity are we estimating remotely in this talk?

Taxonomic diversity

Here, we are using spectral diversity to estimate local taxonomic diversity

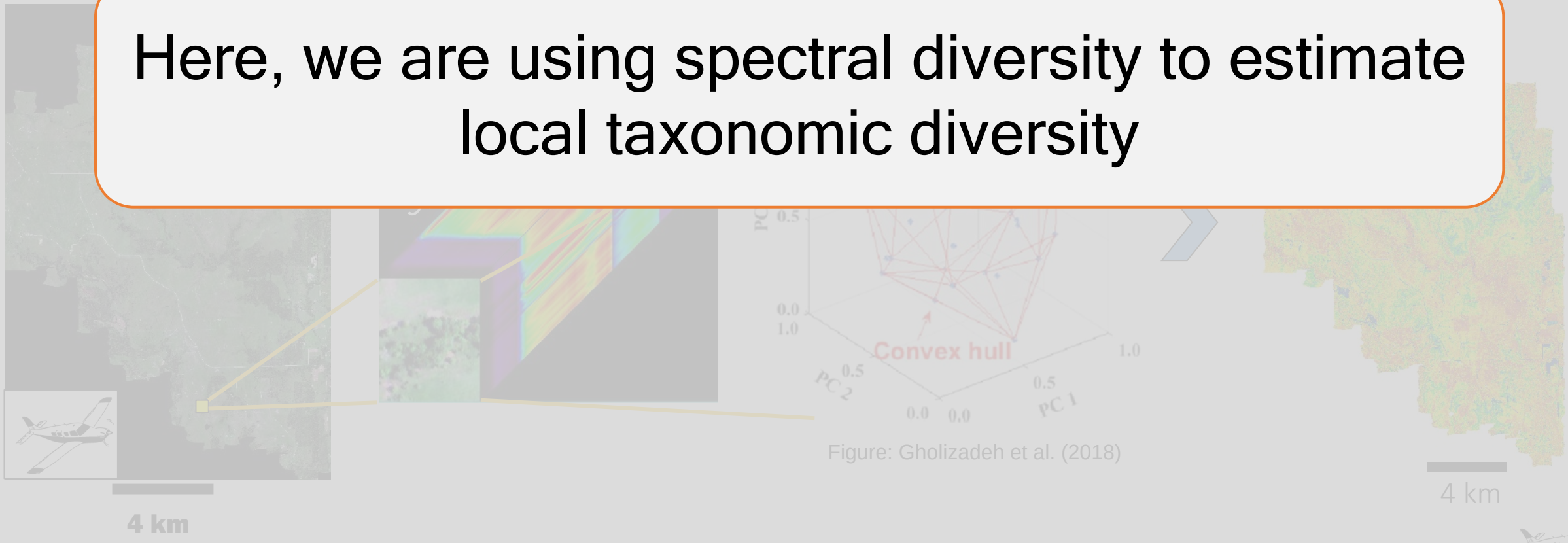
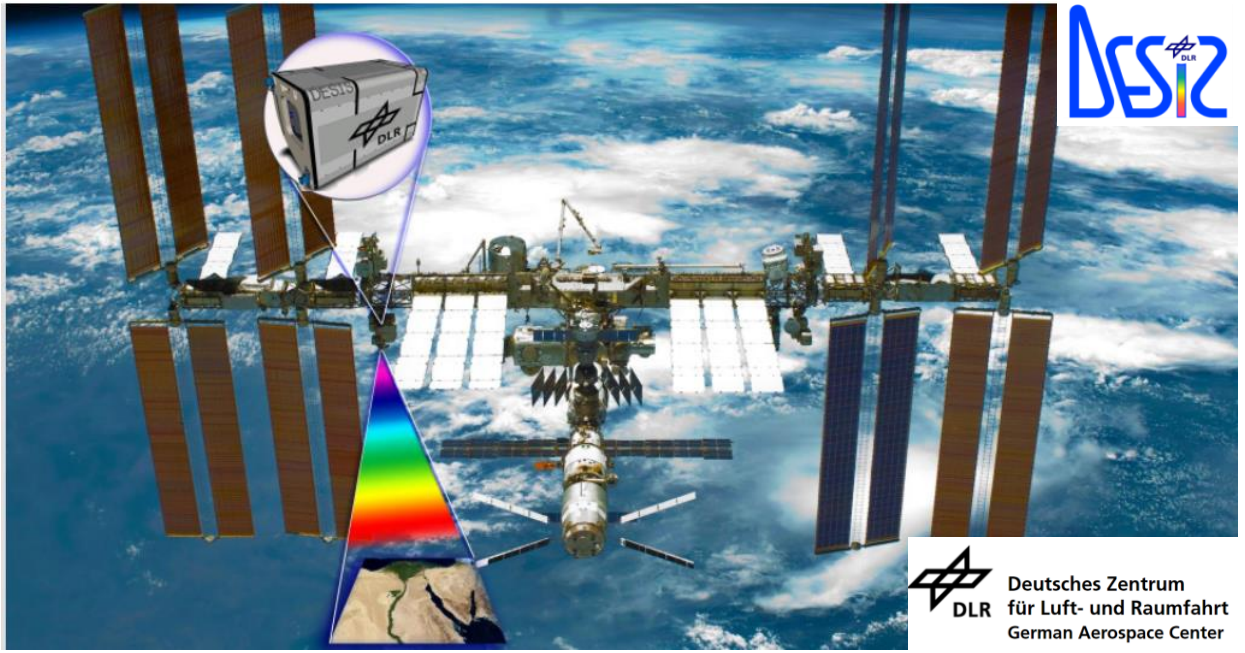


Figure: Gholizadeh et al. (2018)

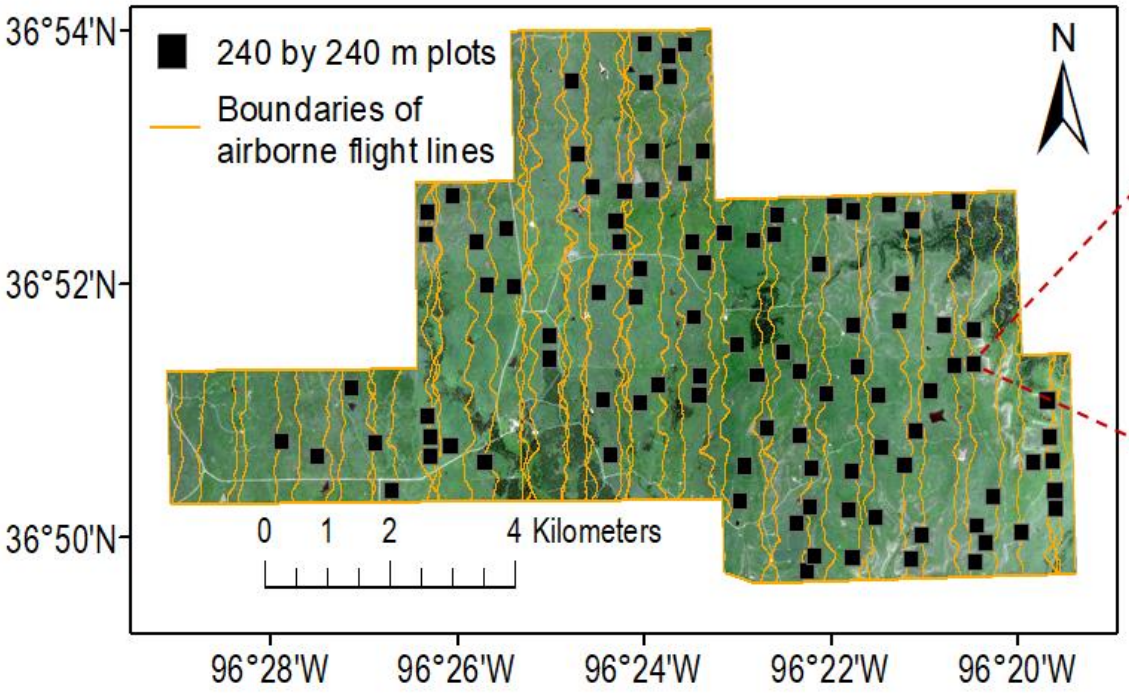
We are currently using airborne and DLR's DESIS data

Hyperspectral data from aircraft

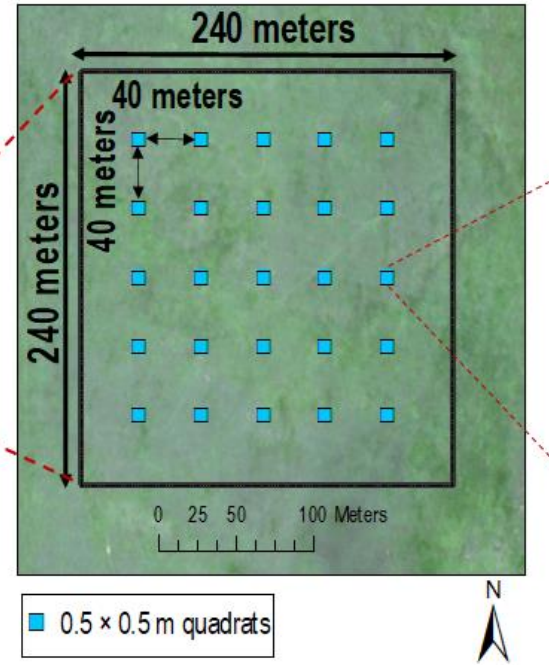
Hyperspectral data from DESIS (somehow similar to SBG)



Joseph H. Williams Tallgrass Prairie Preserve, Oklahoma



100 plots

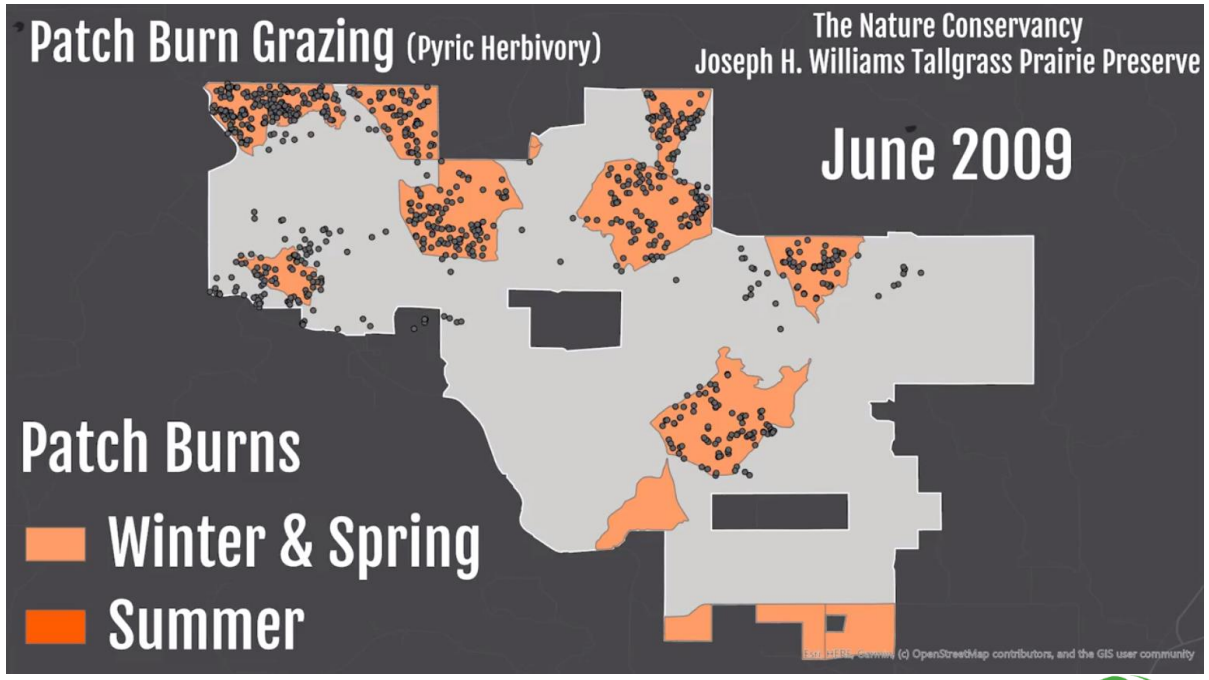


Sampling plot

0.5 m

Sampling quadrat
(total of 2,500 quadrats)

Management practices in grasslands: fire and grazing



OSU Natural Resources Extension
The Prairie Project

The Nature Conservancy

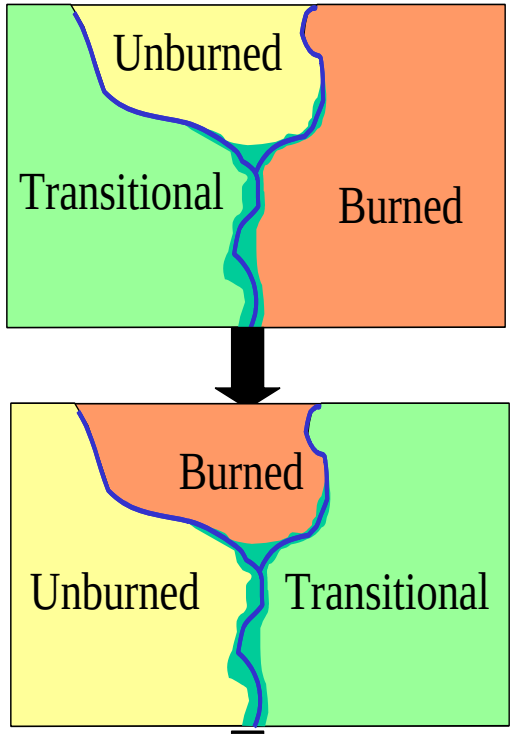


Figure: Fuhlendorf and Engle (2004)

We expressed *in-situ* plant α-diversity using the first three Hill numbers

Index	Hill number	Interpretation
Species richness	0	Number of observed species in a plant community.
Exponential Shannon entropy index	1	Gives weight to species proportional to their abundance.
Inverse Simpson concentration index	2	Effective number of dominant species in a plant community. Gives more weight to dominant species in a plant community.

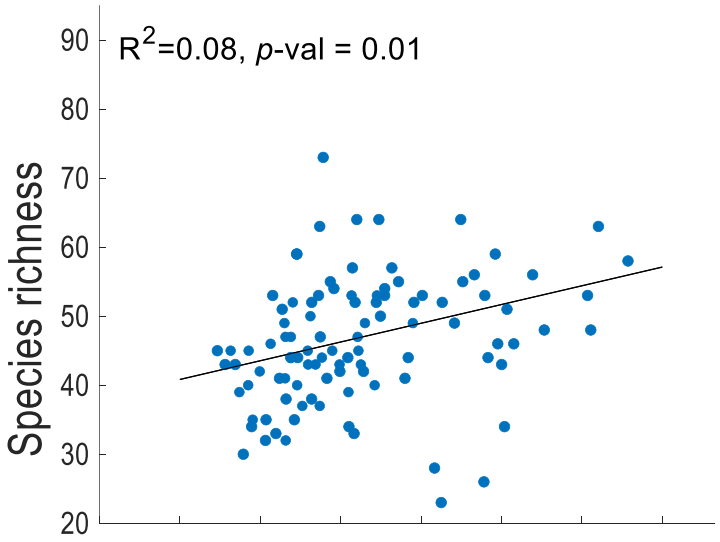
Question 1: What are we capturing remotely?

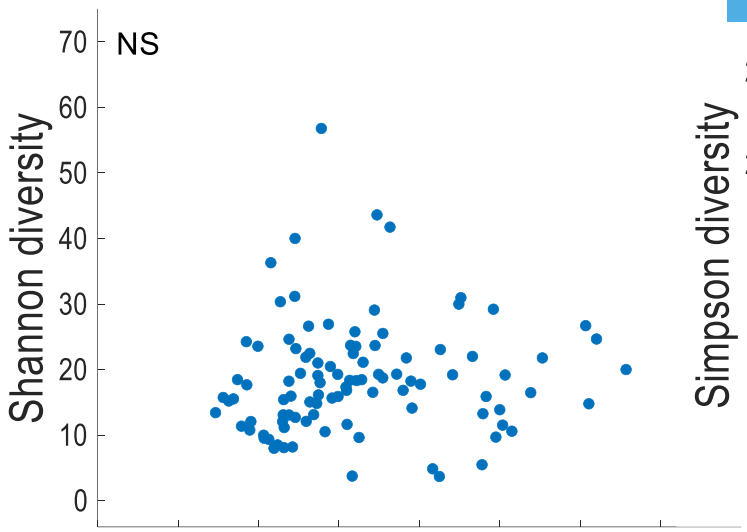
Species richness, Shannon diversity, or Simpson diversity?

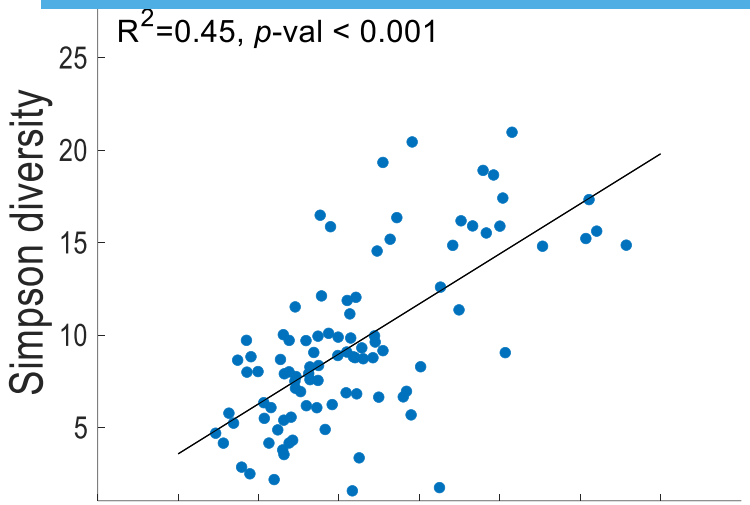
Species richness

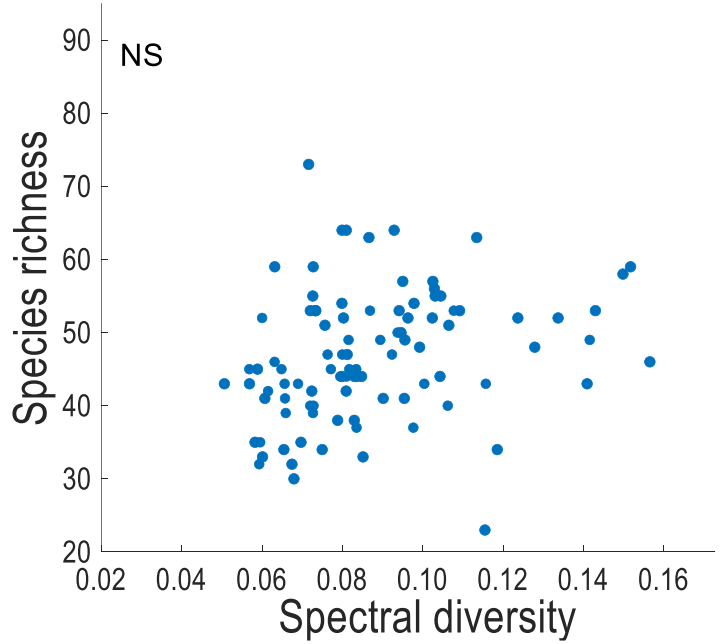
Shannon diversity

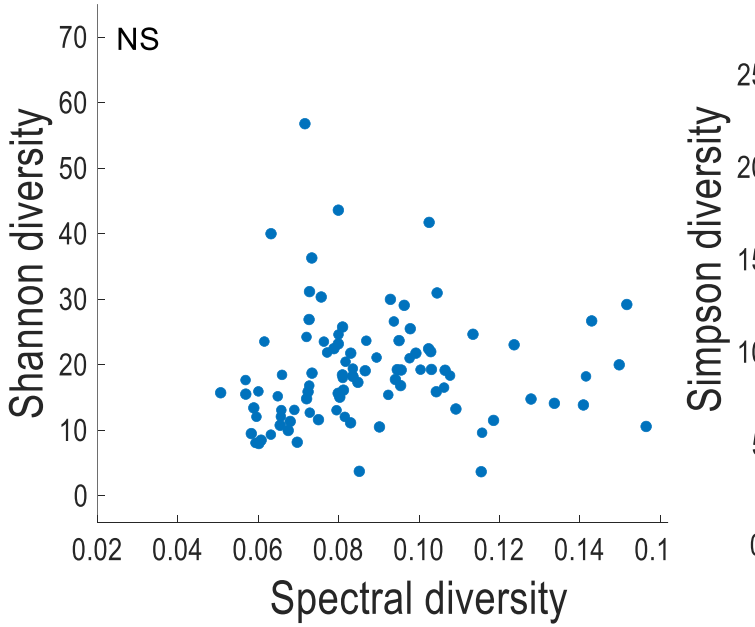
Simpson diversity (dominant species)

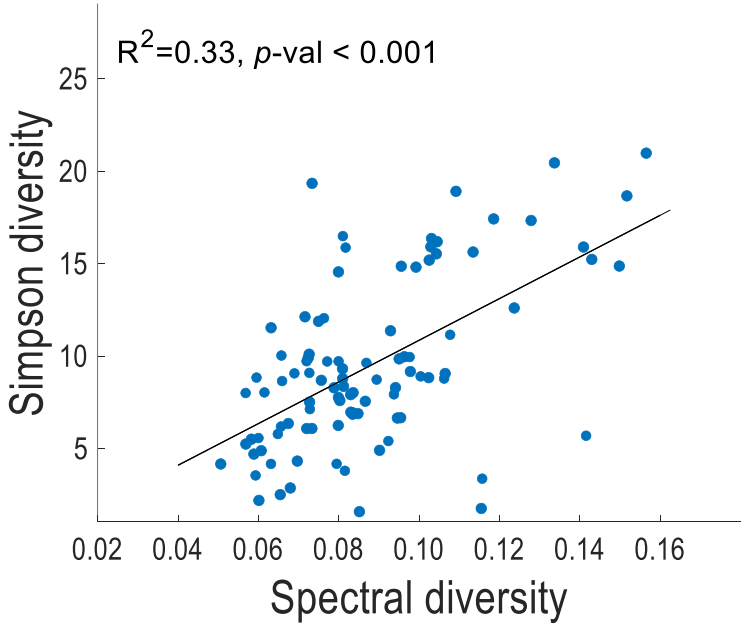










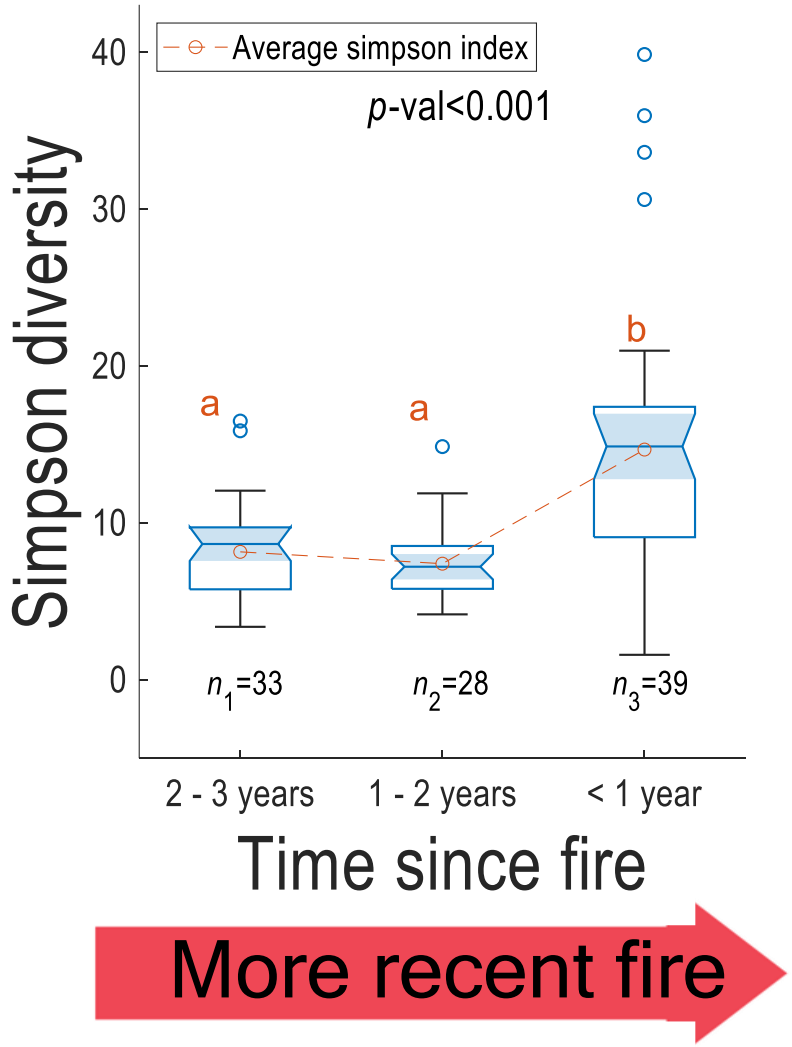


Out of approximately 250 observed plant species, about 80% of them had percent cover of 1% or less.

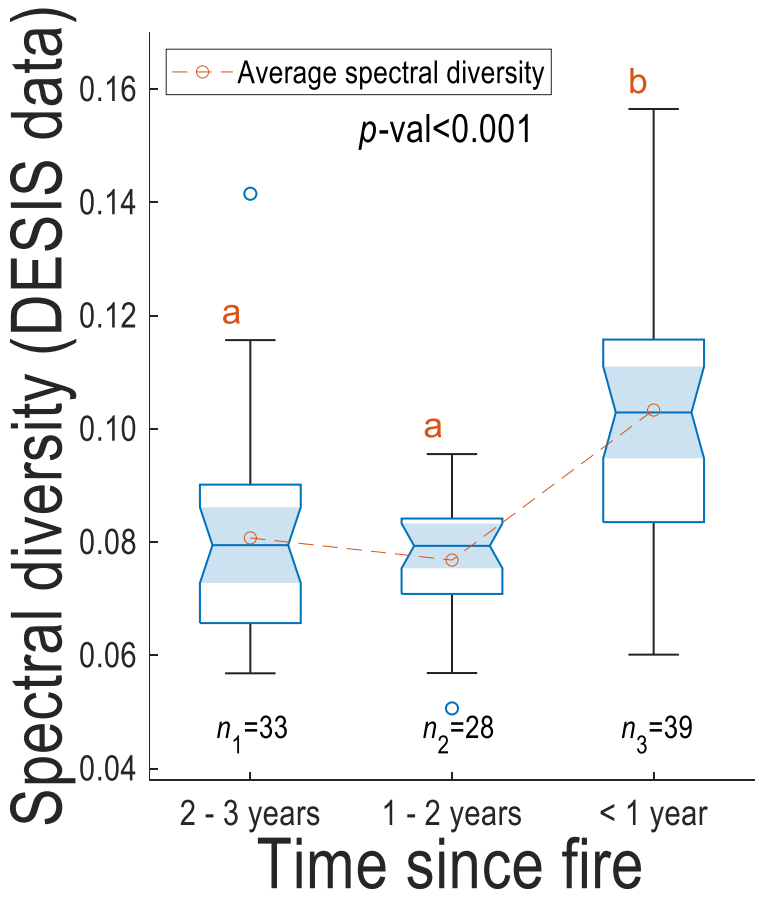
Dominant species drive the plant diversity-spectral diversity relationship

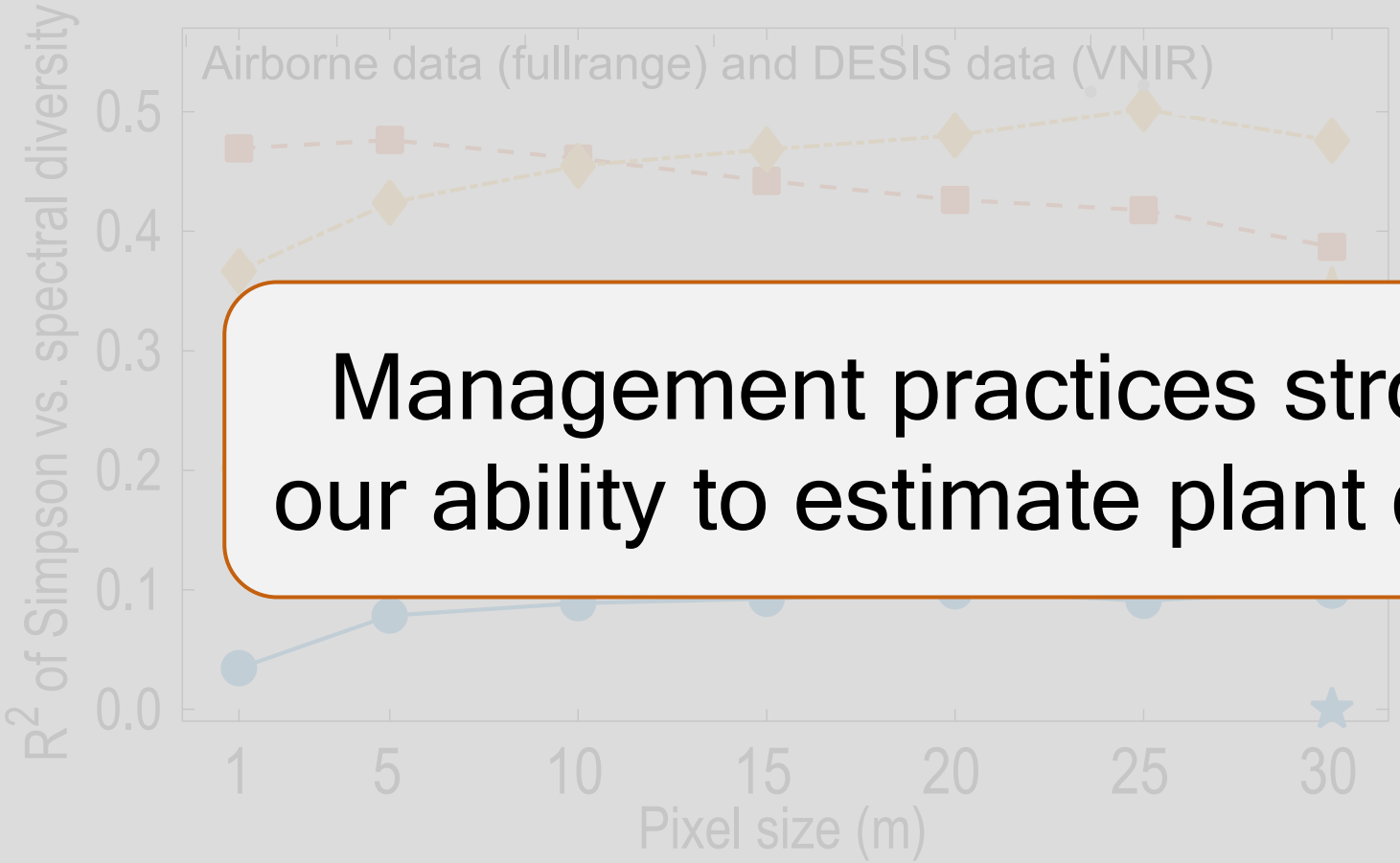
Question 2: Do management practices affect our ability to capture plant diversity remotely?

Management practices influenced measured and remotely-sensed plant diversity



More recent fire





Recently-burned plots or those at the transitional

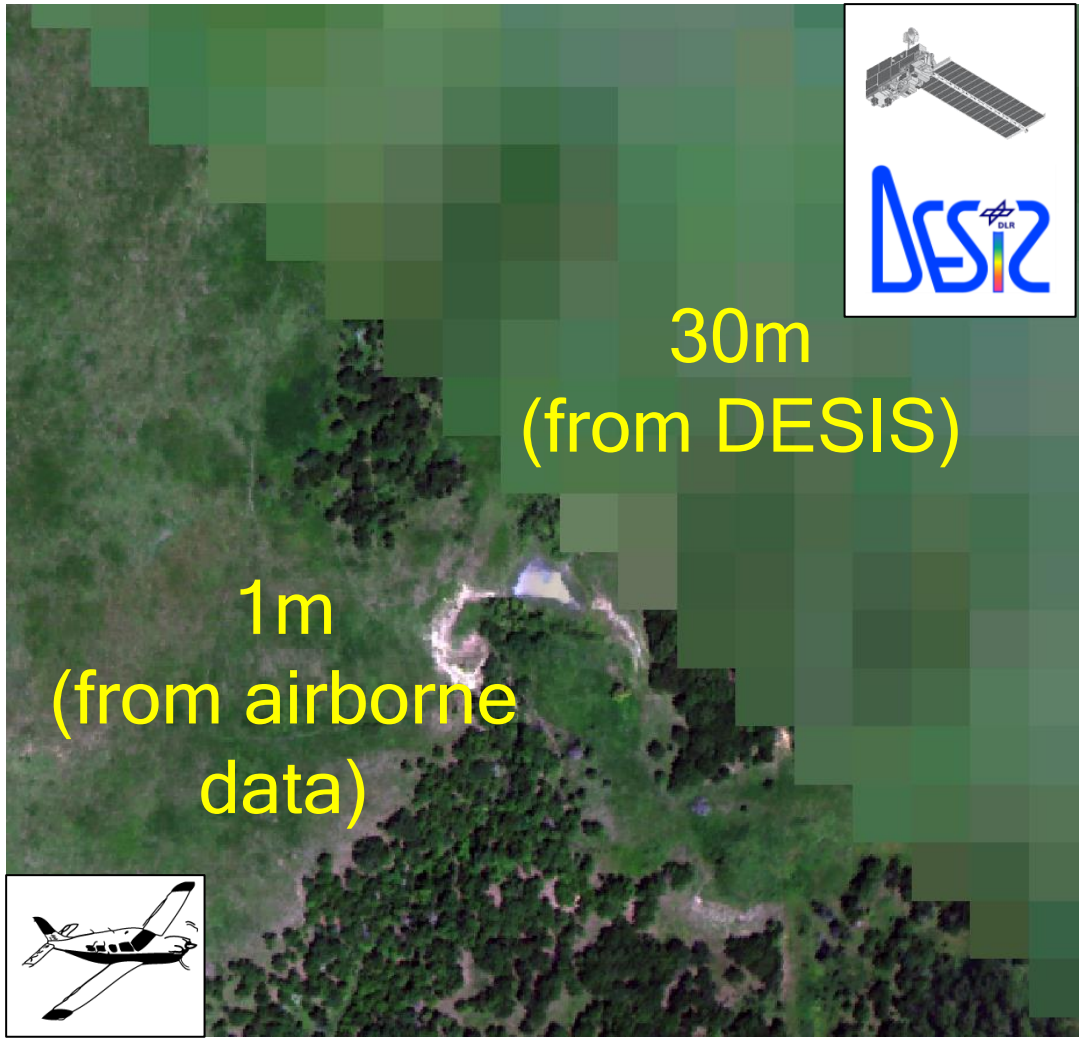
2 - 3 years after fire

Management practices strongly influenced our ability to estimate plant diversity remotely

Gholizadeh, et al., RSE, *In press*

Future work: Taking it to the *sub-pixel* level!

Large pixels of SGB-type data



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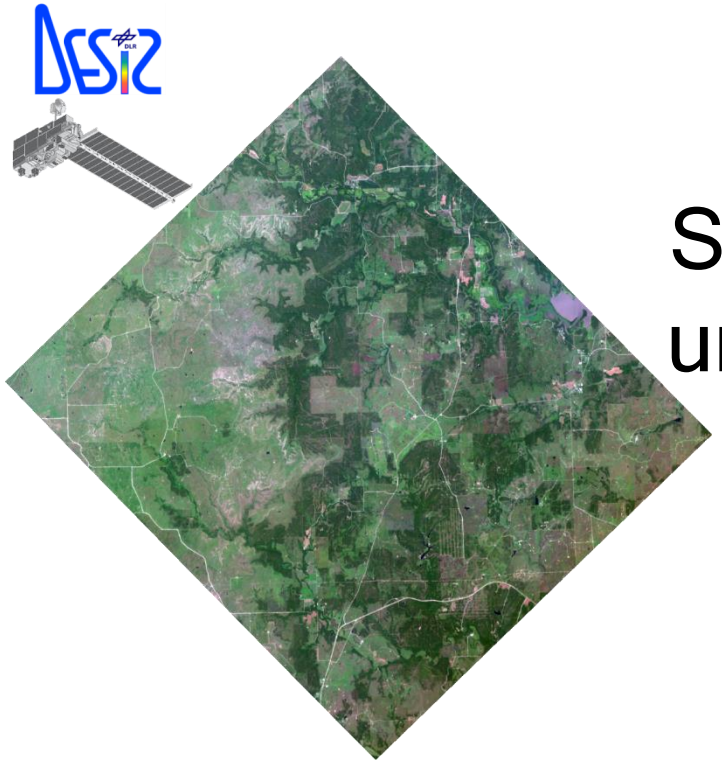
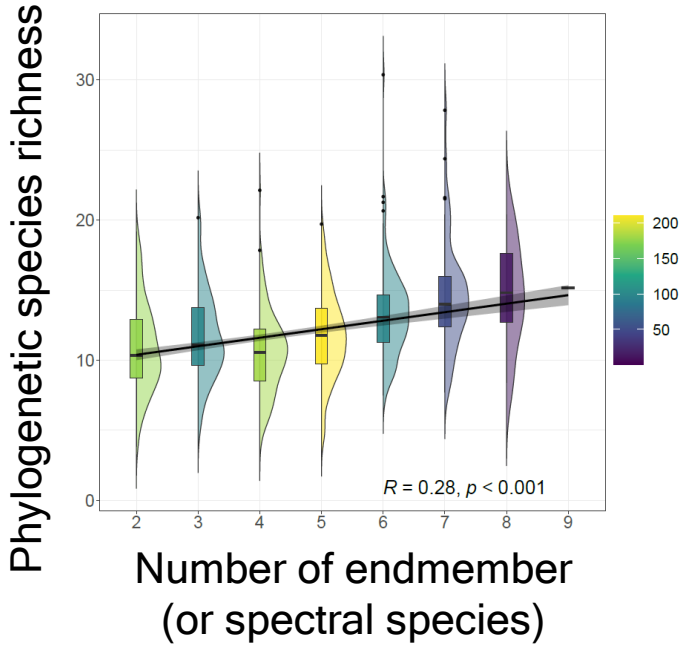
Small plants

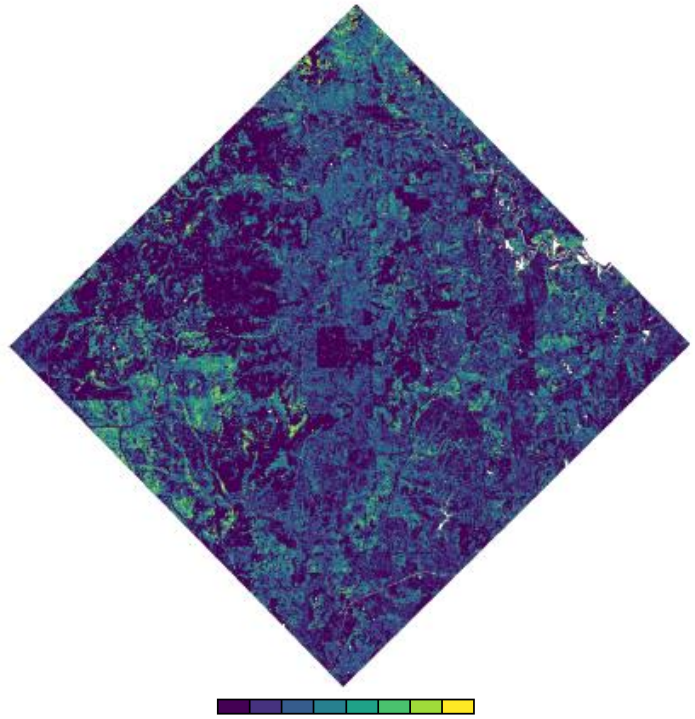
0.5 m

Future work: Taking it to the *sub-pixel* level!



Spectral unmixing





Thank you!