



Moffat County Agriculture

Mapping Rangeland Vegetation Attributes
to Inform Grazing Management in Moffat
County

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Colorado – Fort Collins | Fall 2024



Background

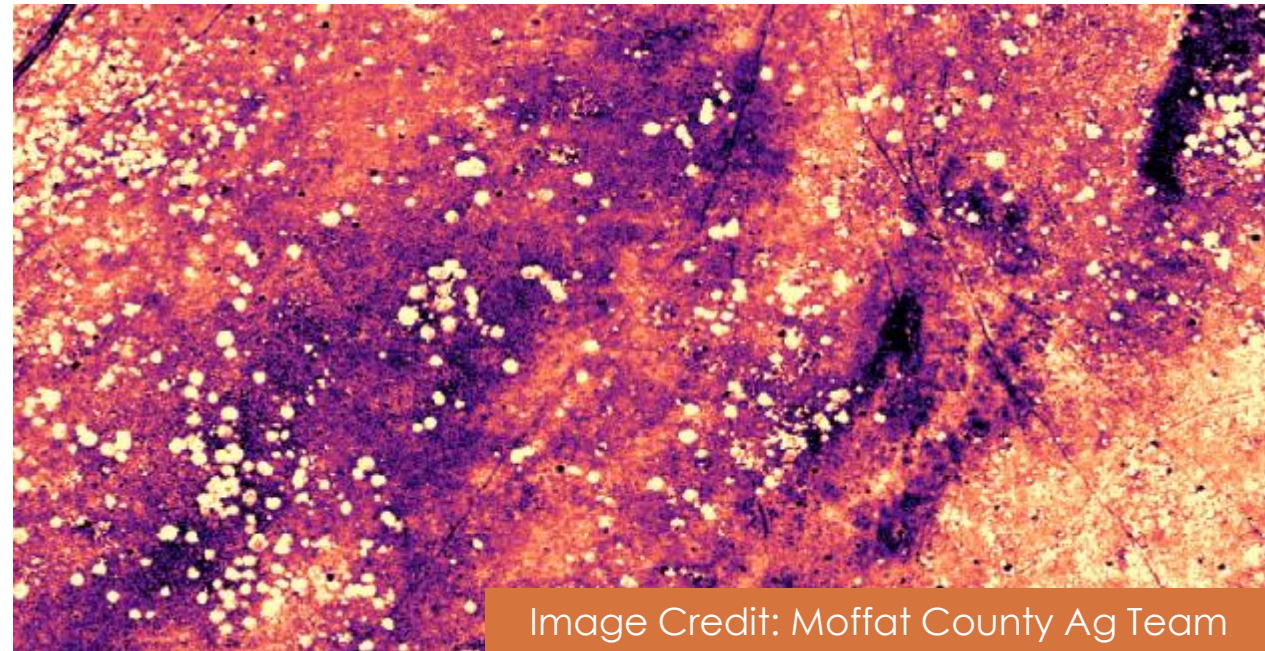
Rangelands

- Play a critical role in ecosystem function
- Commonly support livestock grazing



Remote Sensing

- Offers monitoring at a relevant scale



Partners & Community Concerns

Partners

- Camblin Ranch
 - Mike & Danna Camblin
- The Nature Conservancy – Regenerative Grazing Lands Strategy

Community Concerns

- Sustainable rangeland management
- Biodiversity and wildlife
- Novel management tools such as virtual fencing
- Opportunities to apply remote sensing to management



Image Credit: Jack Hagenbuch

Project Objectives

1

Evaluate rangeland remote sensing datasets and products

2

Map the distribution of herbaceous, shrub, and bare ground cover

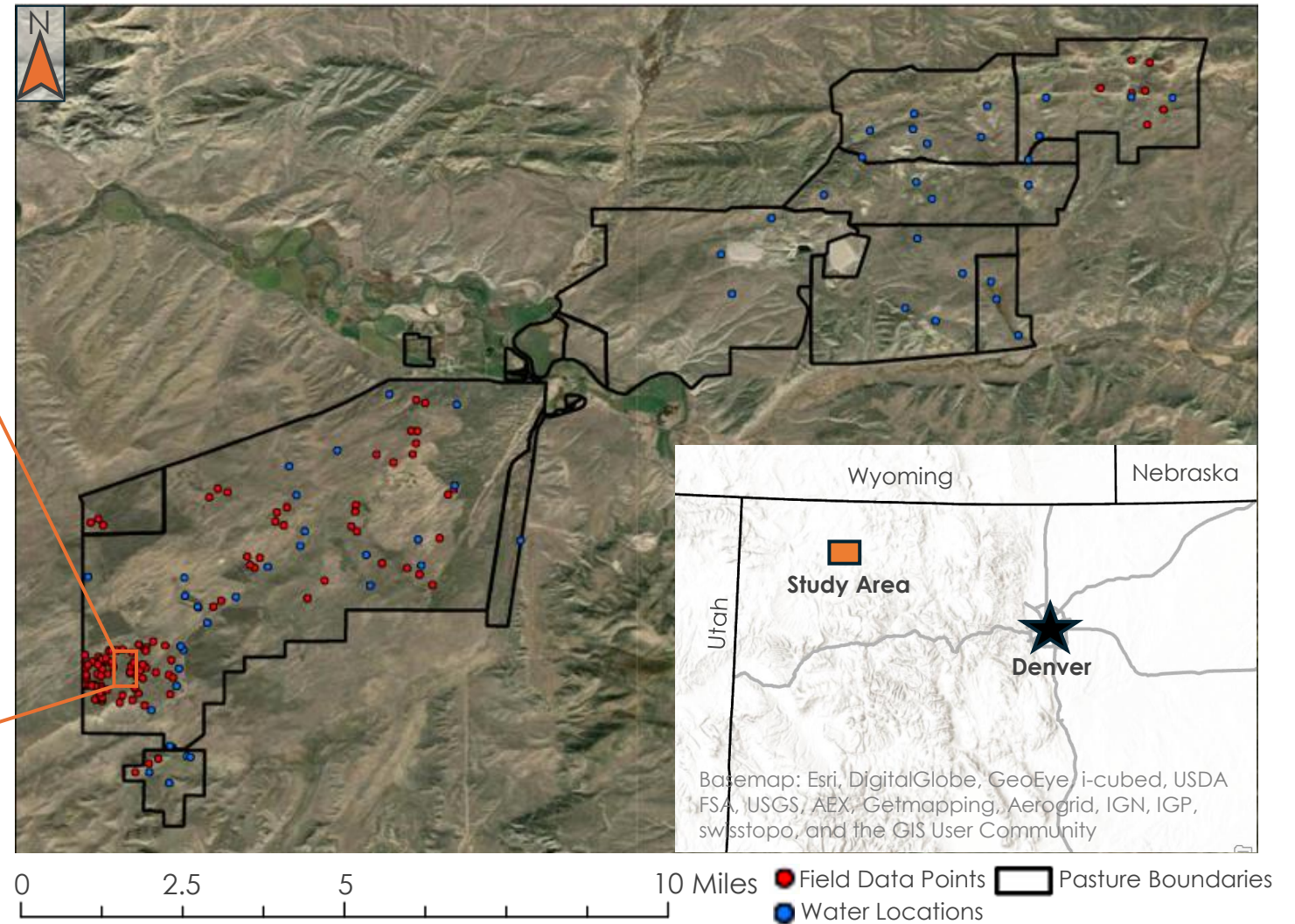
3

Compare the application of different remote sensing products for range monitoring

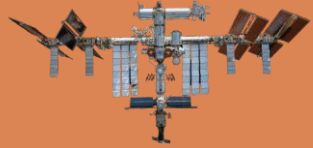
Study Area



Image Credit: Jack Hagenbuch



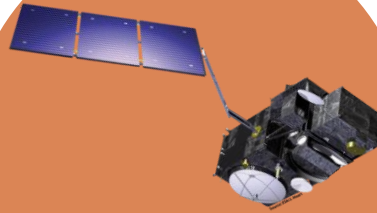
Earth Observations



ISS EMIT
60 meters



Landsat 7 ETM+
30 meters



Landsat 8 OLI
30 meters



Landsat 5 TM
30 meters



Drone
5 centimeters

Bare soil index

Rangeland Analysis Platform (RAP)

**Pixel based cover
classification**

Trends in cover classes

- Maps of bare ground, shrub, and grass distribution
 - Timeseries of % cover from 1986 – 2023
- Linear regression comparing accuracy across platforms

Rangeland Analysis Platform

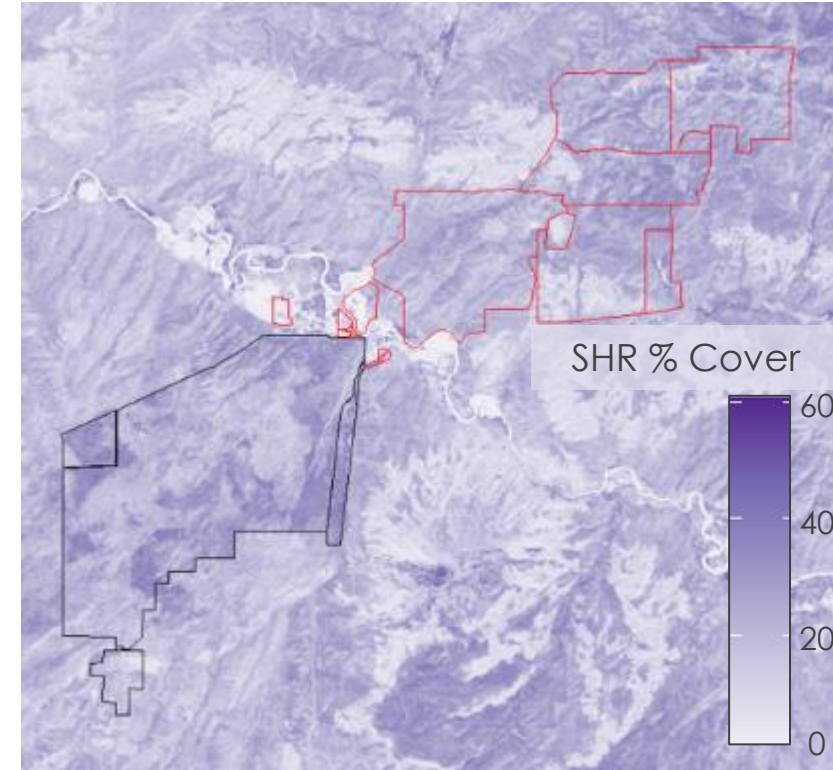
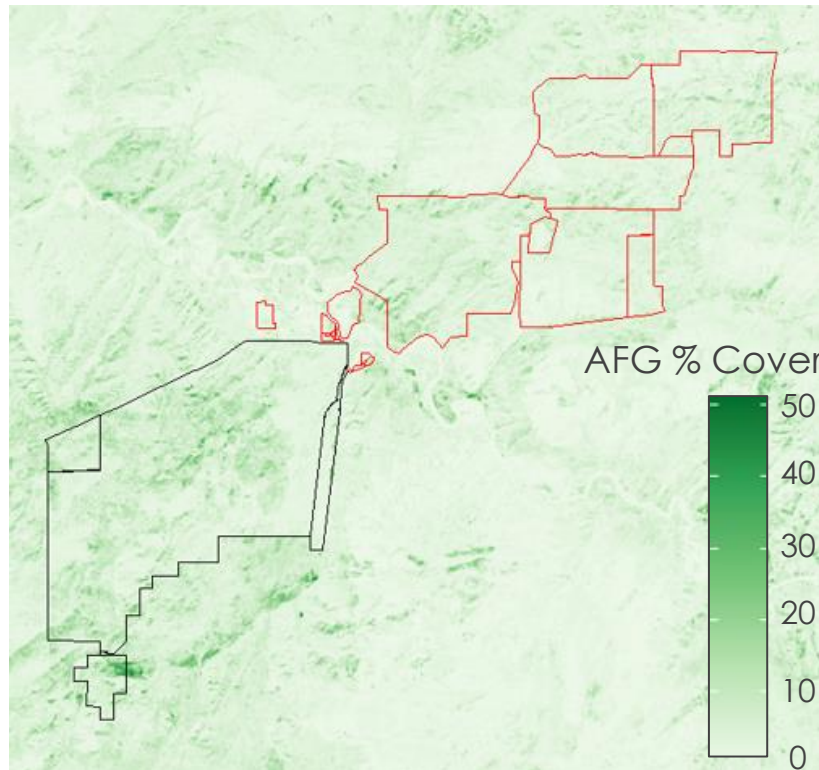
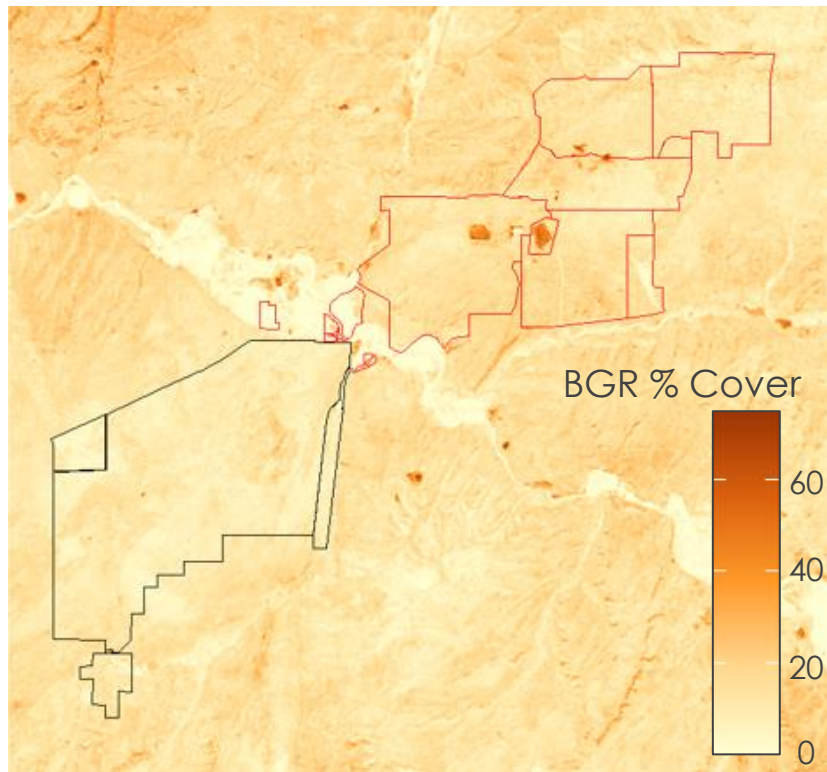
Ranch Pastures

— North
— South

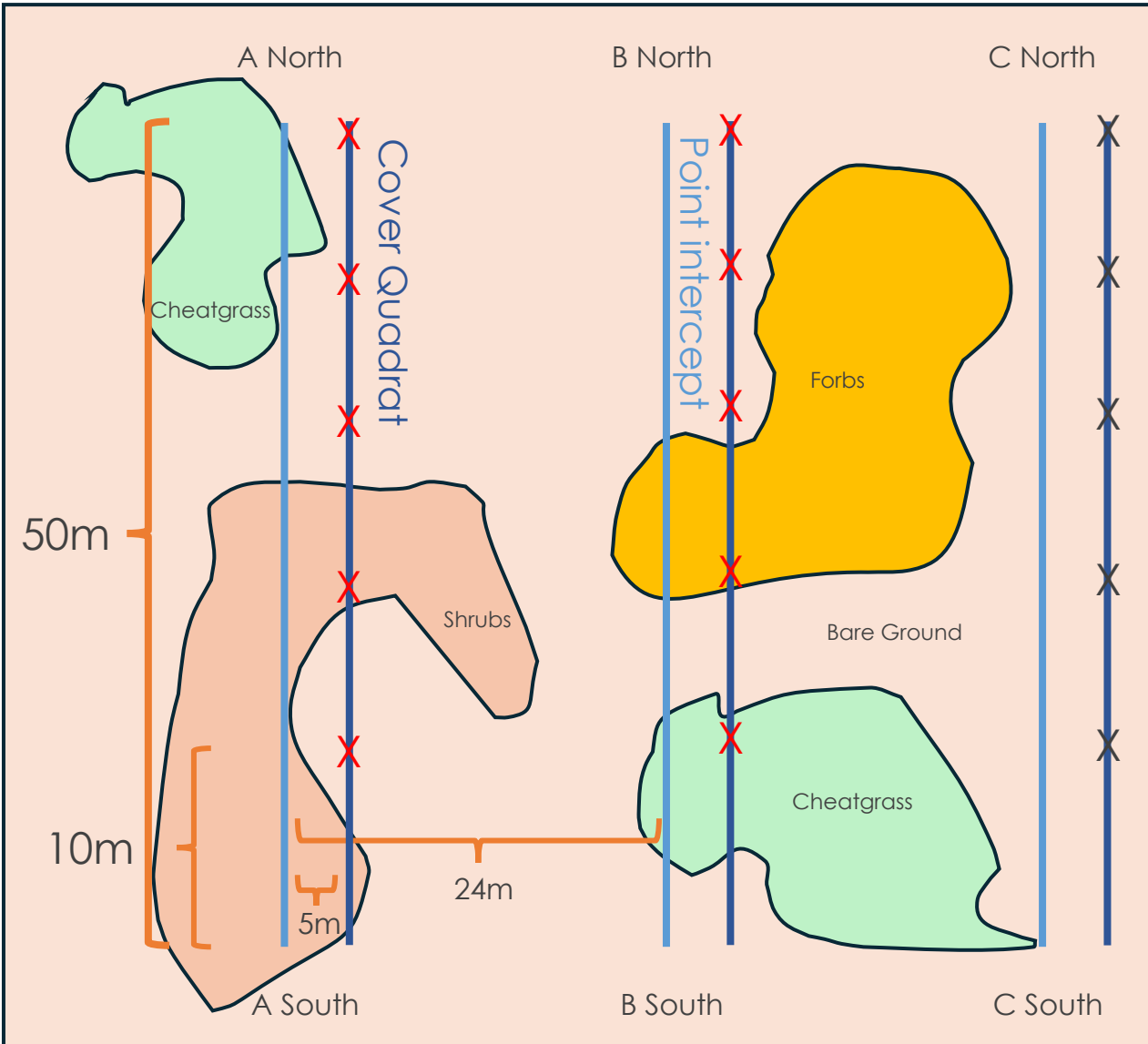
Bare Ground

Annual Forb & Grass

Shrub



Field Data Collection



- Line Point Intercept (60m x 60m)
- Cover Quadrat (20cm x 50cm)



Drone Imagery

Image Collection

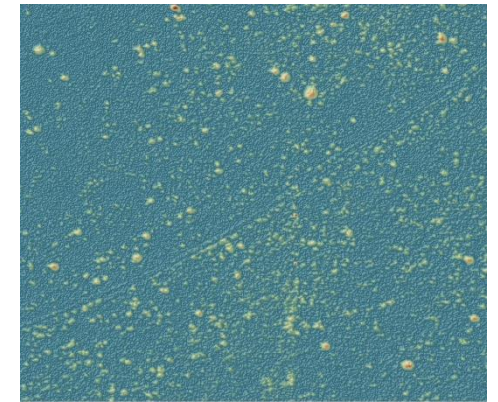


Data Products

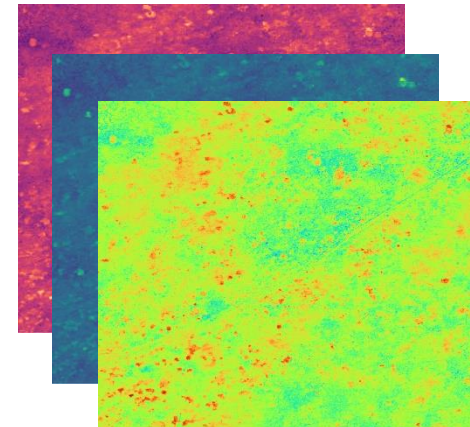
Orthomosaic



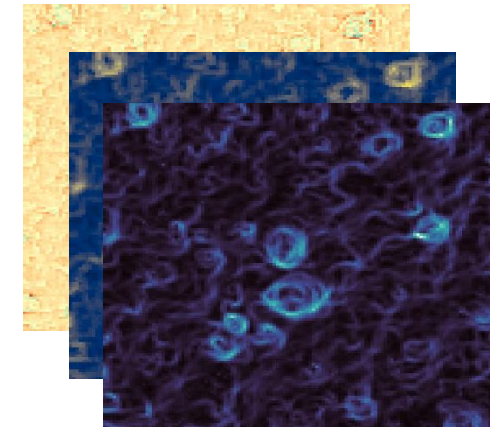
Canopy Height Model



Vegetation Indices

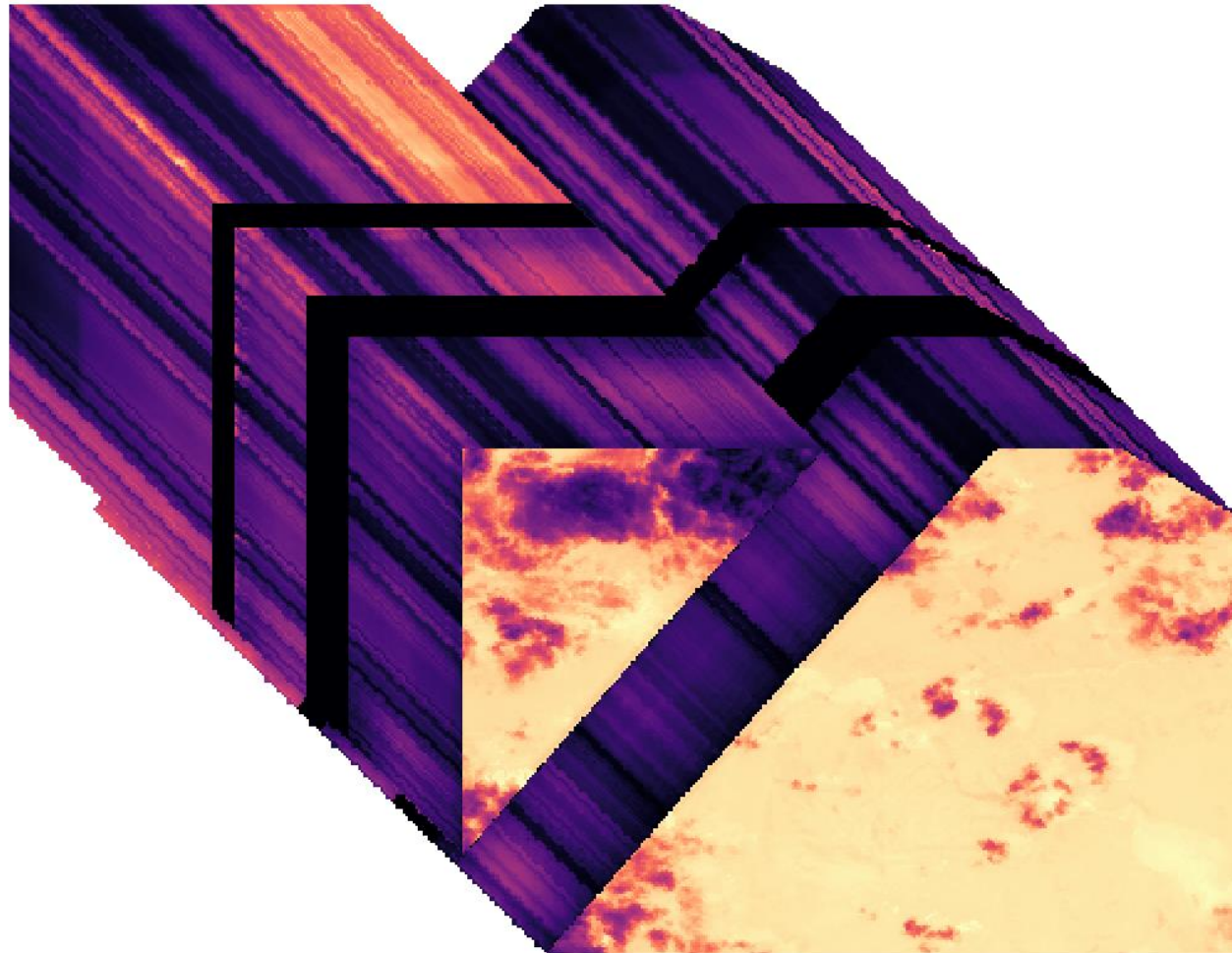


Terrain Metrics

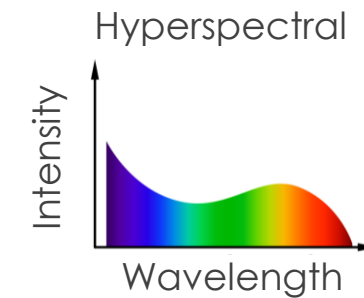
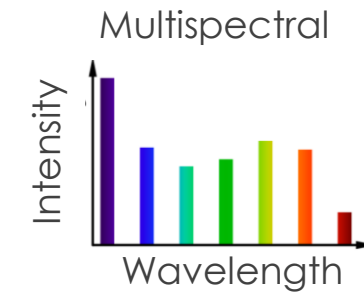
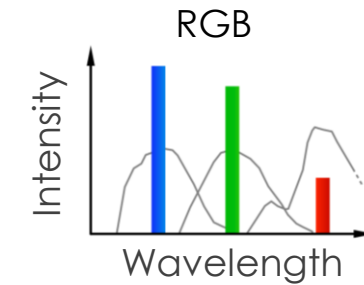


Earth Mineral Dust Source Investigation (EMIT)

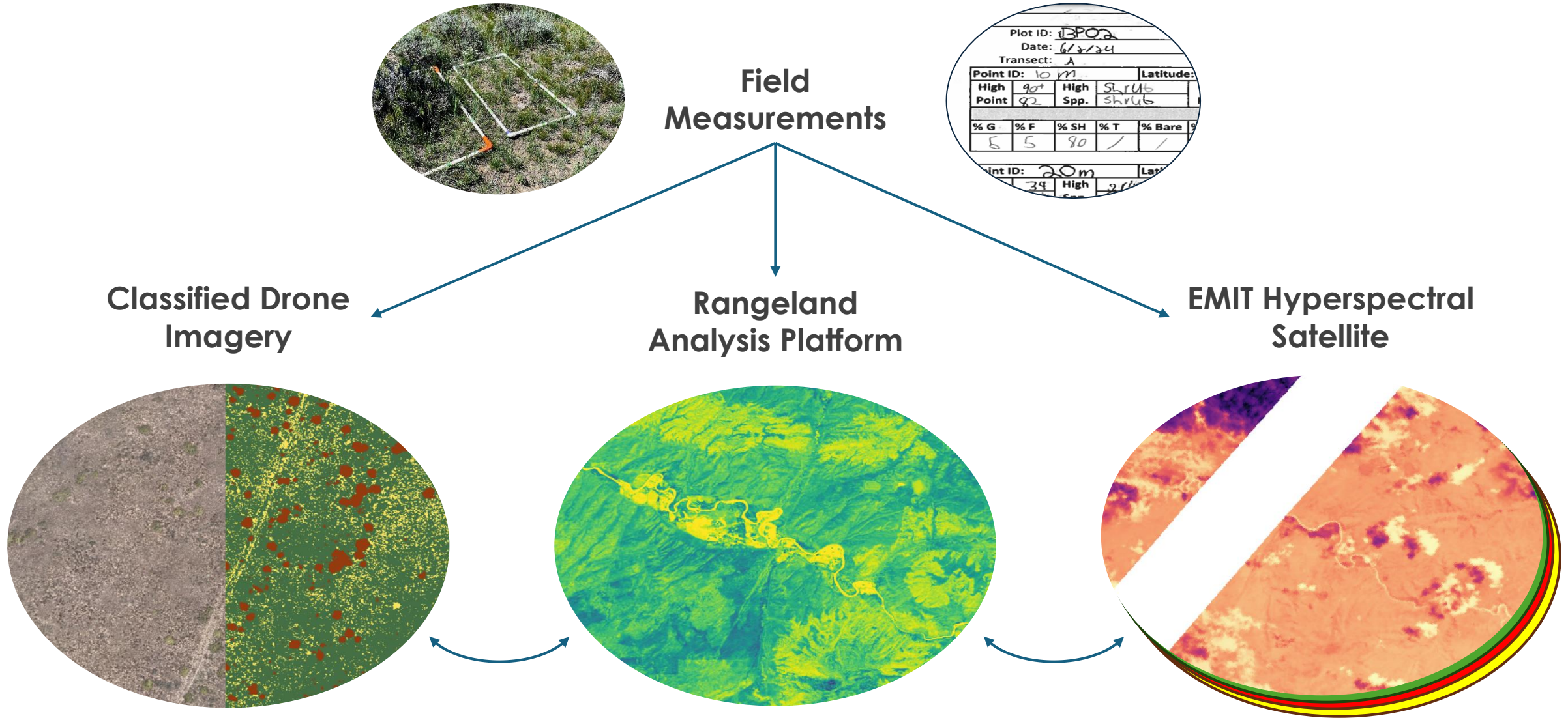
Hyperspectral Data Cube



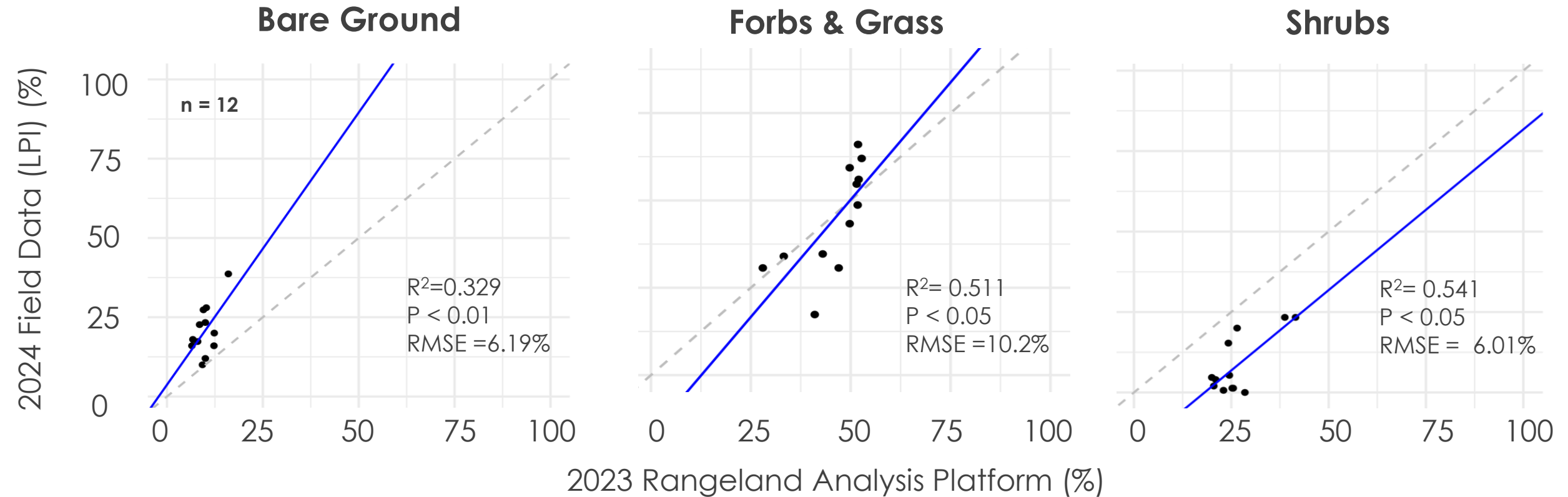
Spectral Resolution Differences



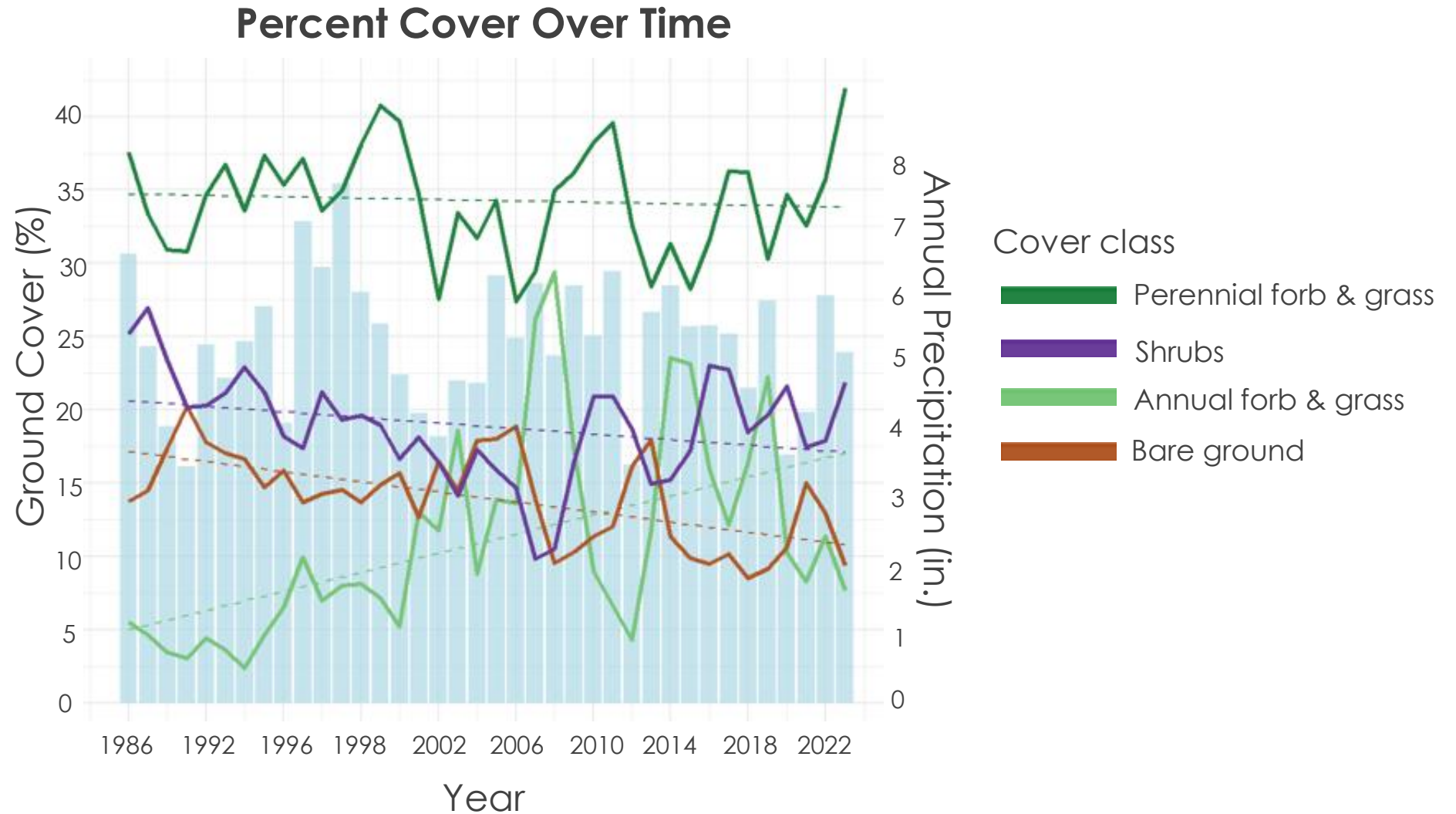
Methodology



Comparing Field Data (LPI) and RAP



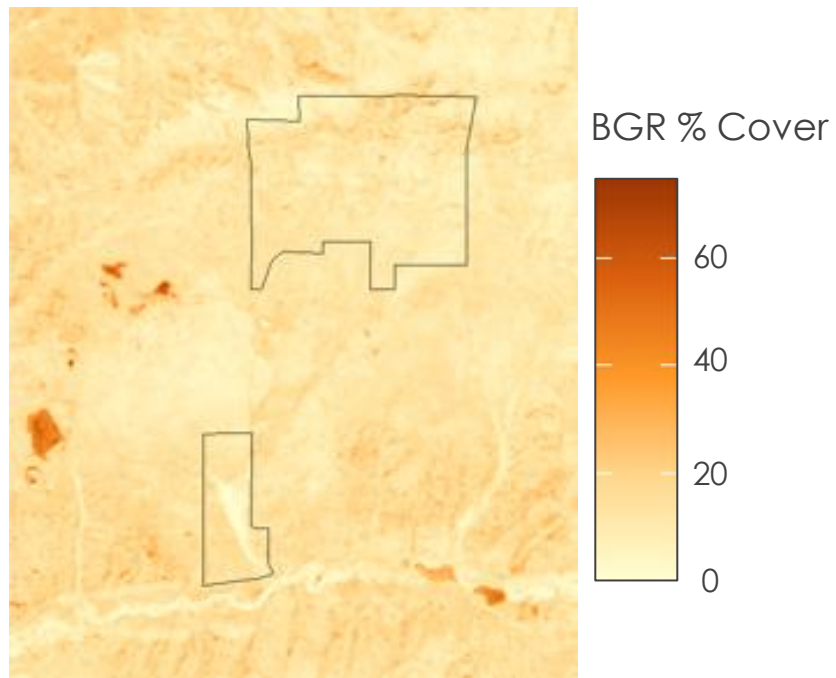
Rangeland Analysis Platform Timeseries



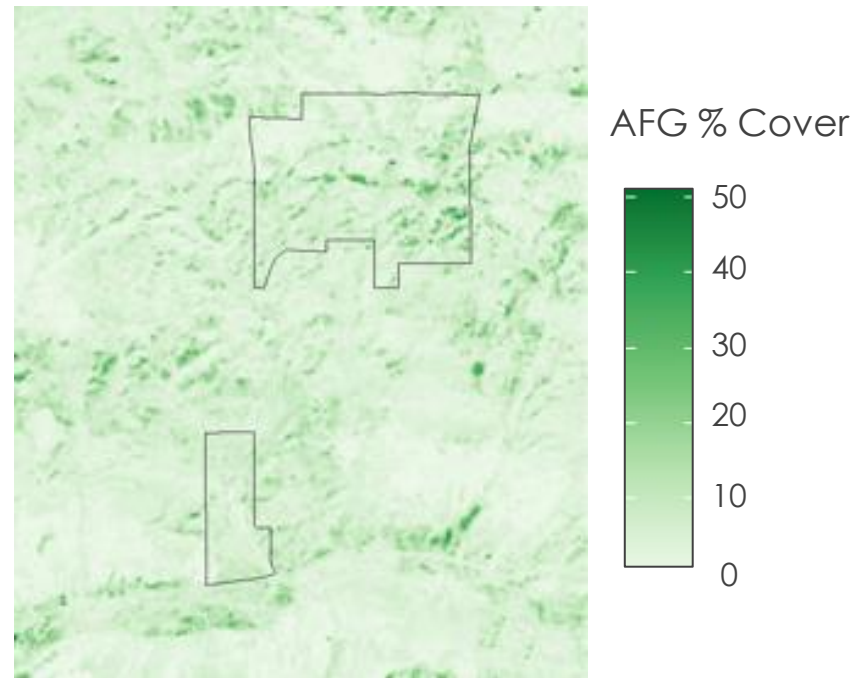
RAP – Focal Pastures % Cover

2023 Percent Cover – Focal Pastures

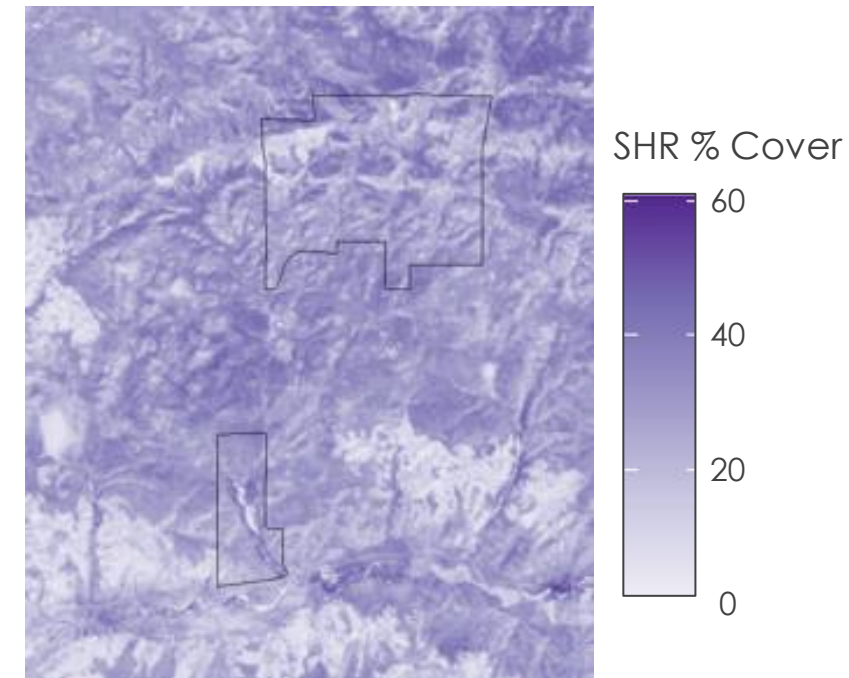
Bare Ground Cover



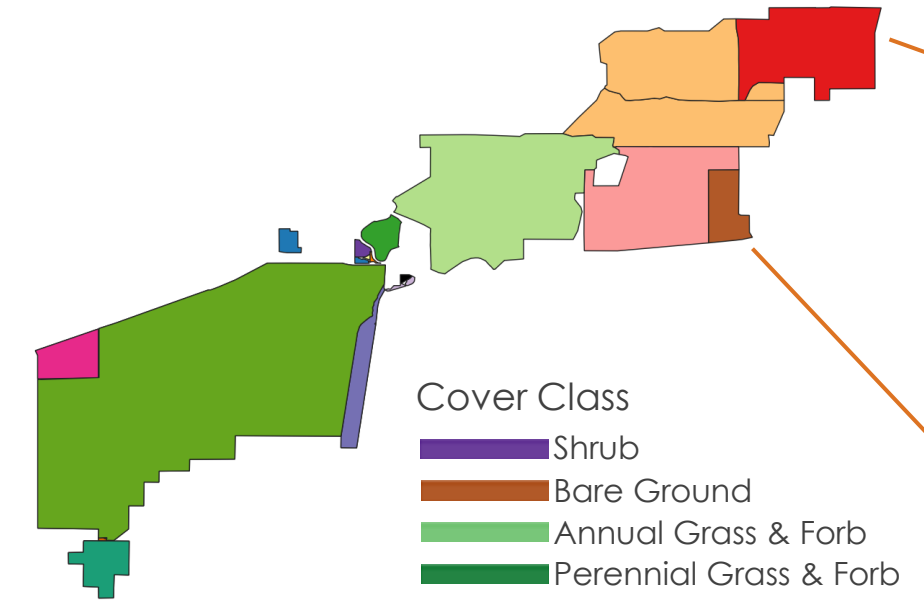
Annual Forb & Grass Cover



Shrub Cover



RAP – Focal pastures timeseries

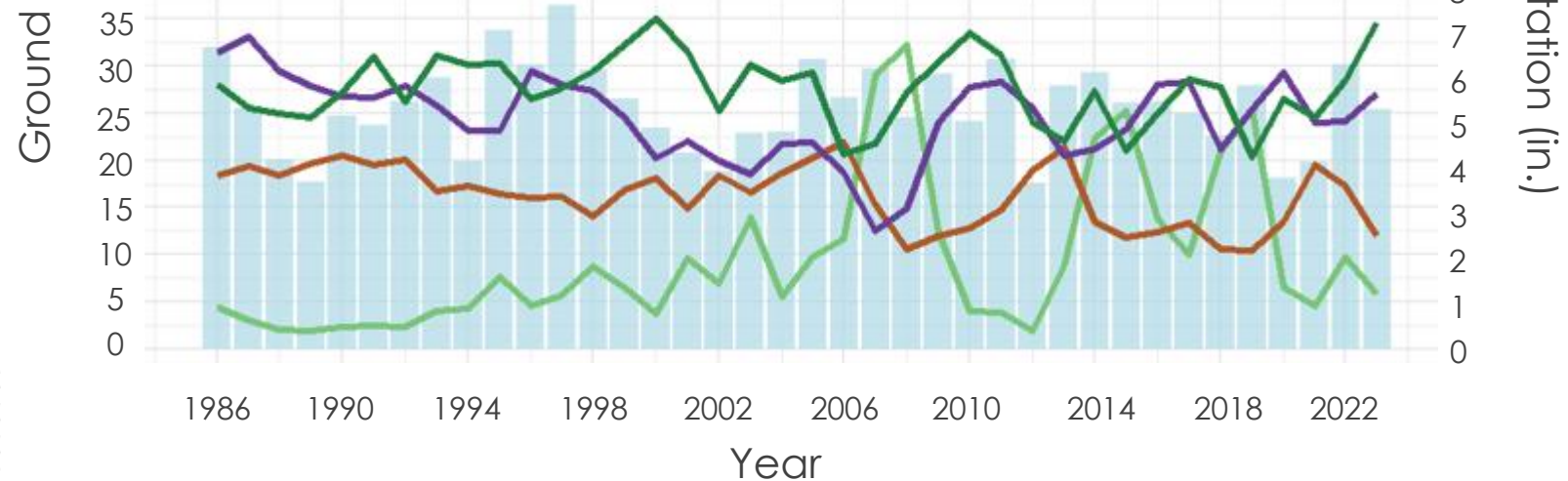


Percent Cover Over Time

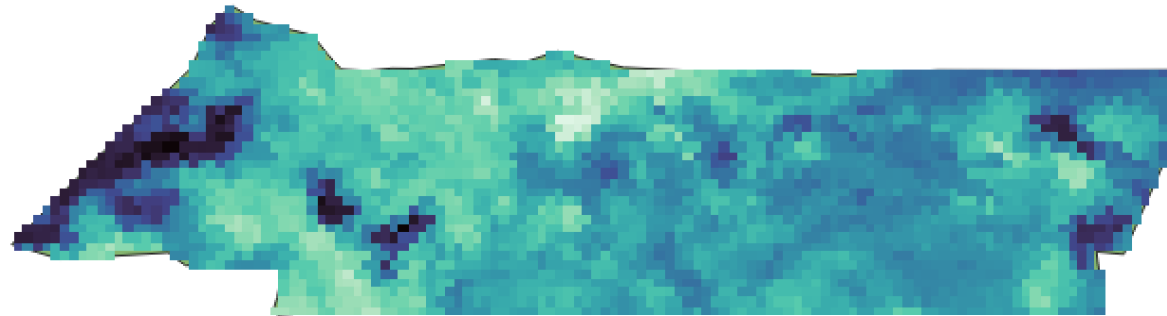
North Pasture F



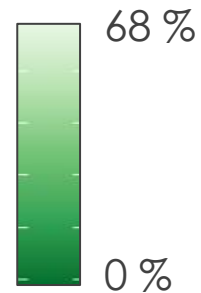
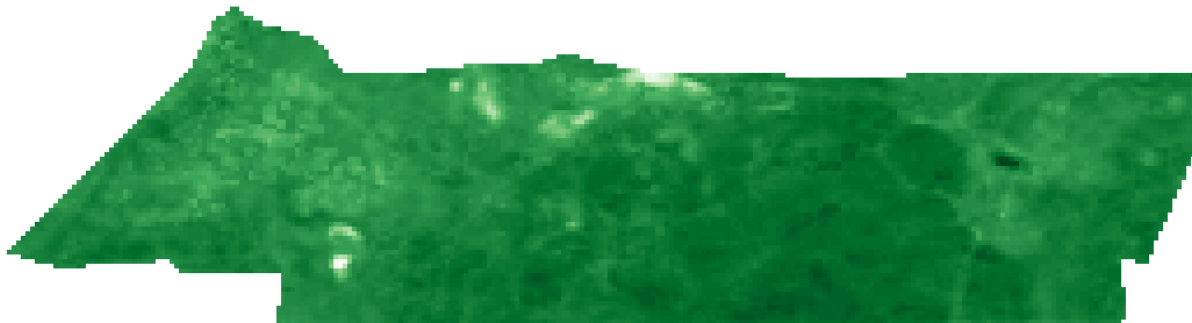
North Pasture L



Mapping Bare Ground with EMIT



**Hyperspectral Bare
Soil Index
(EMIT)**

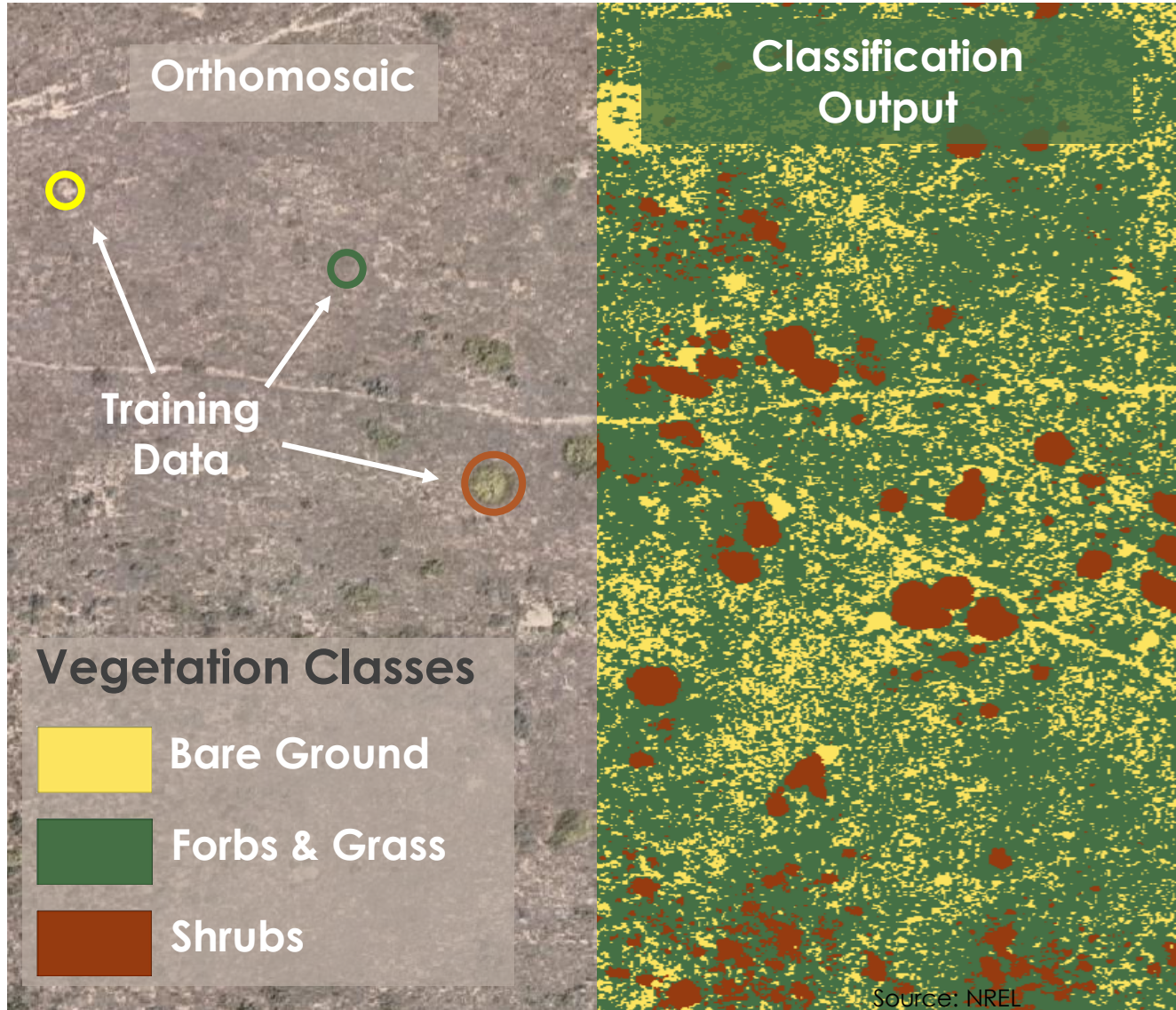


**Bare Ground
% Cover
(RAP)**

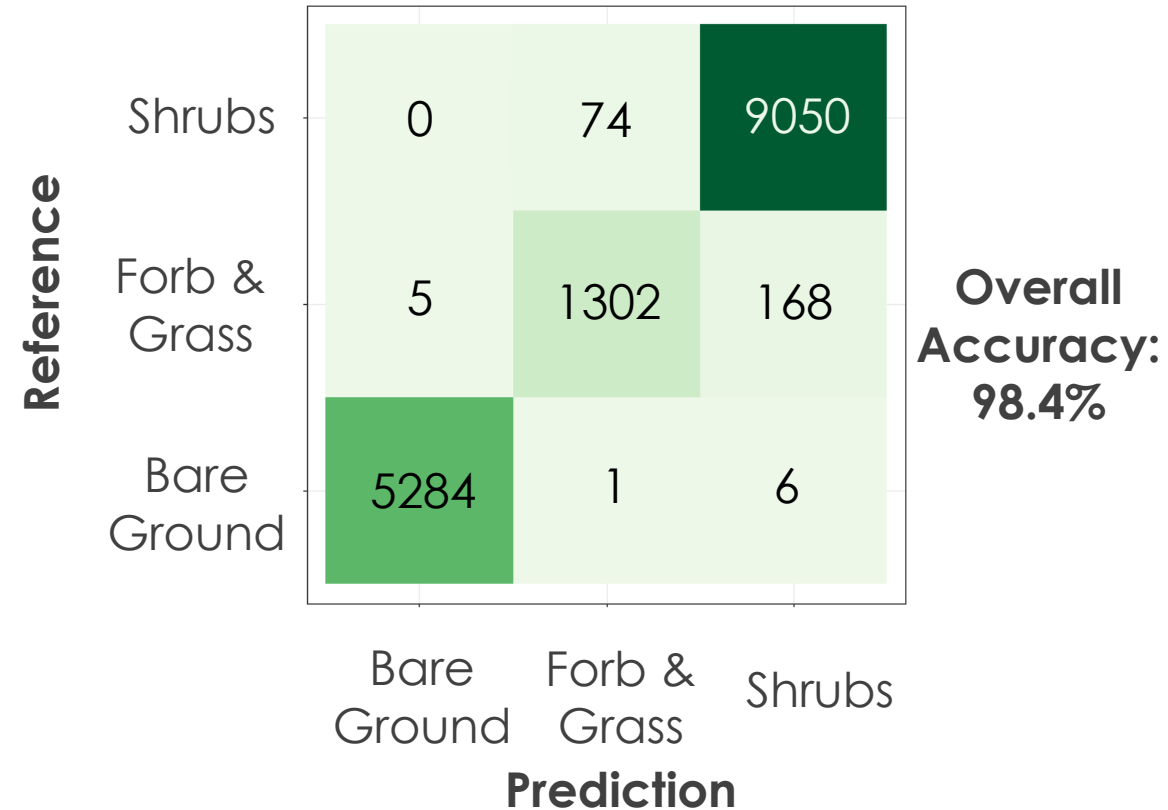


**High Resolution
RGB
(NAIP)**

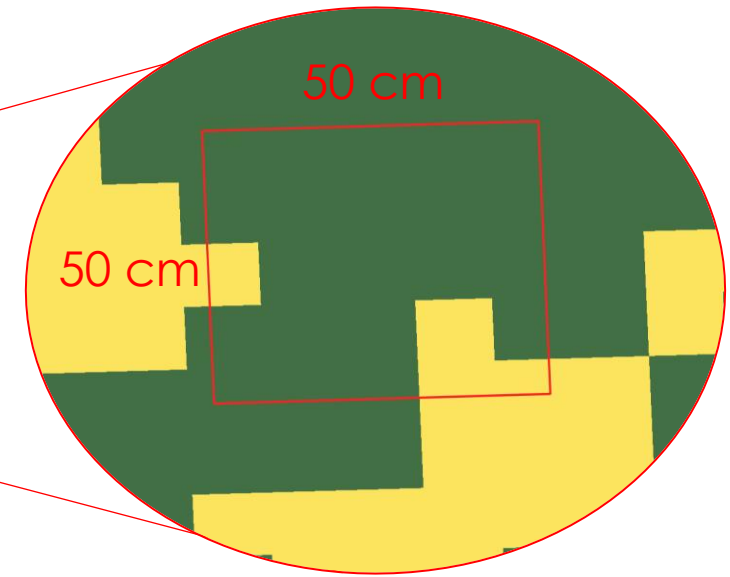
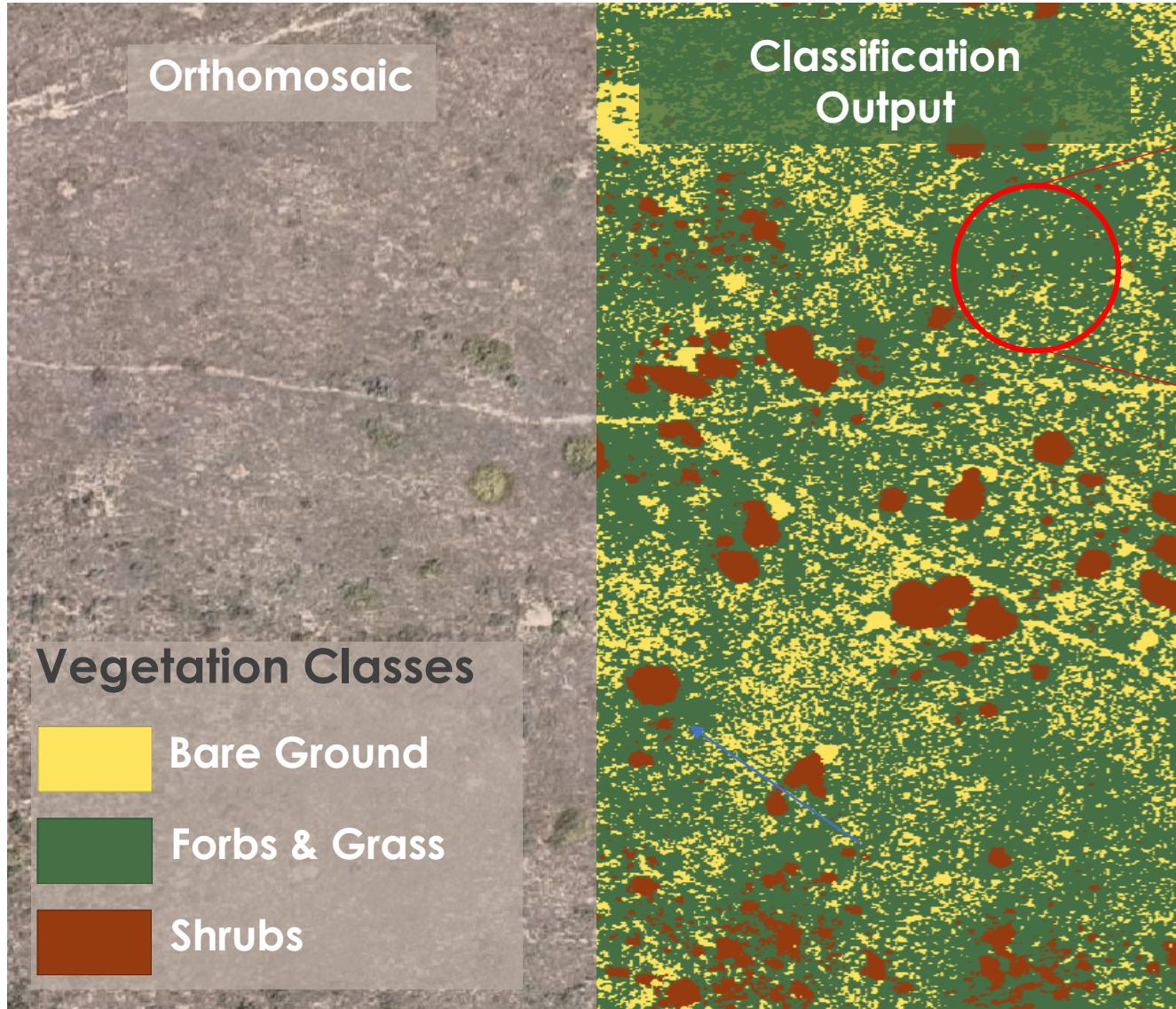
Drone Imagery Classification



Pixel Based Classification Accuracy Assessment

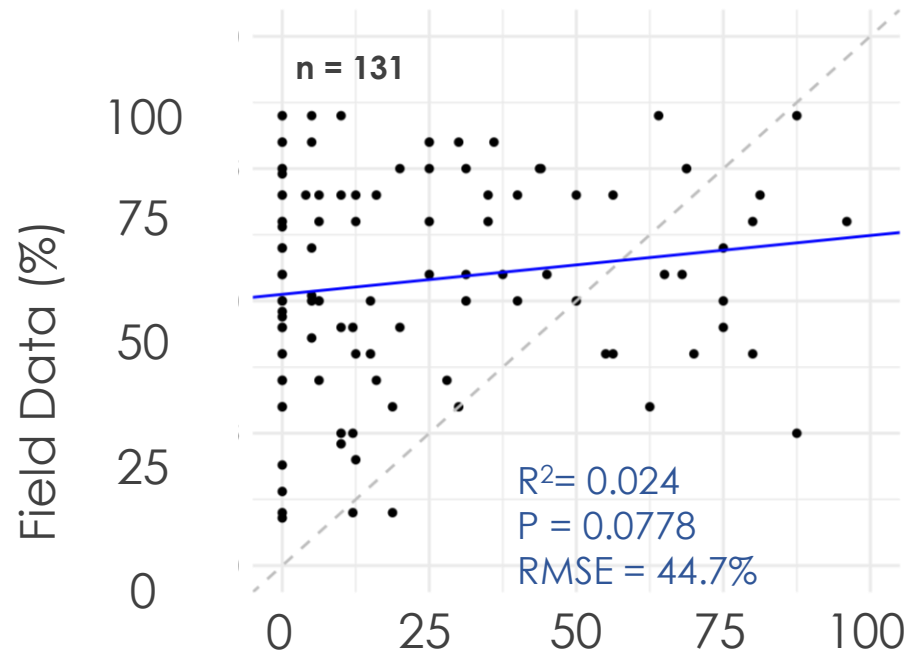


Comparing Field Data to Drone Imagery

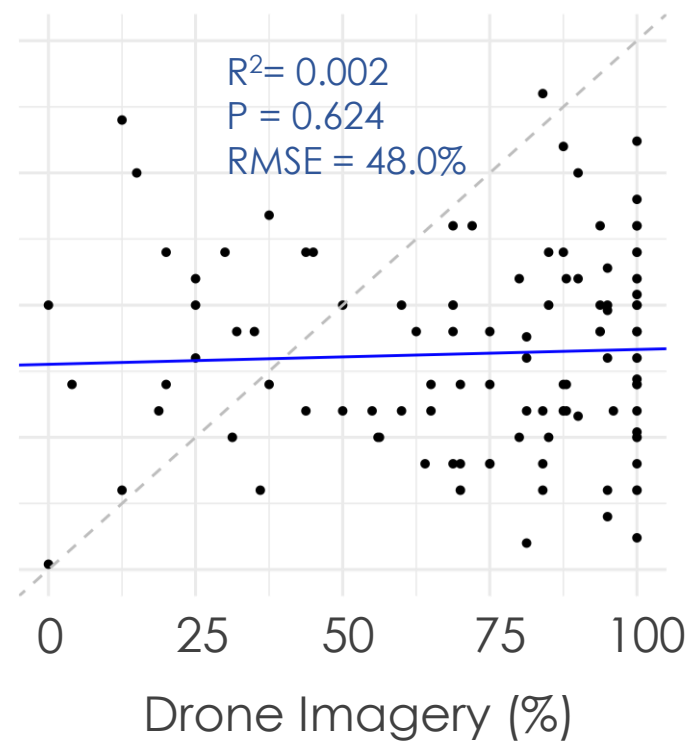


Comparing Field Data (Quadrat) to Drone Imagery

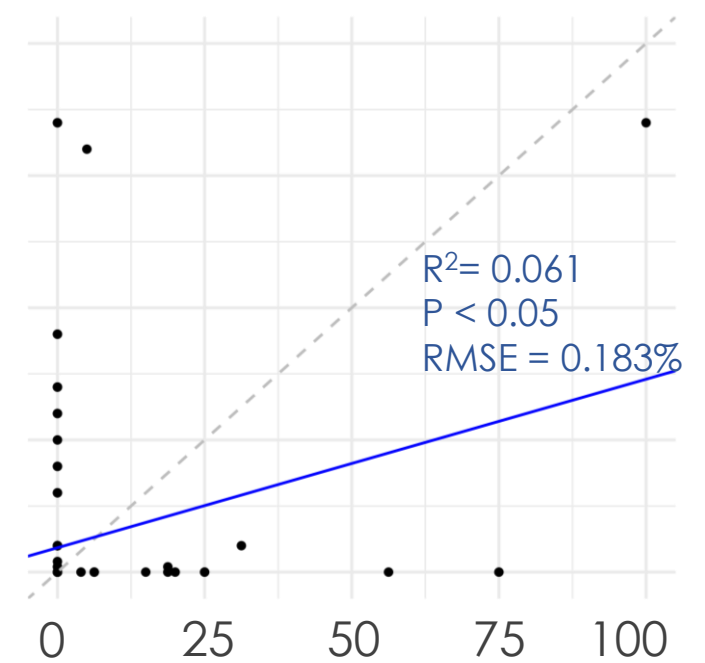
Bare Ground



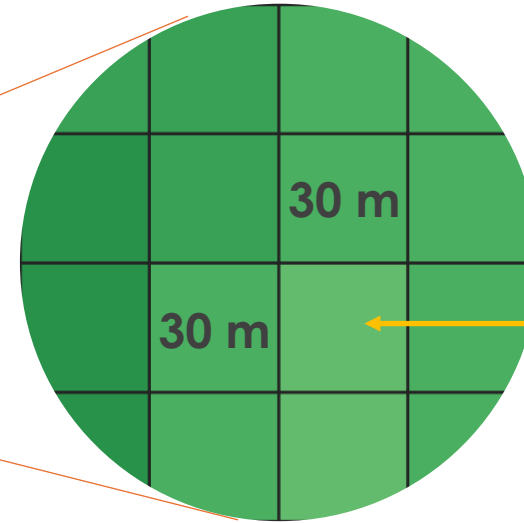
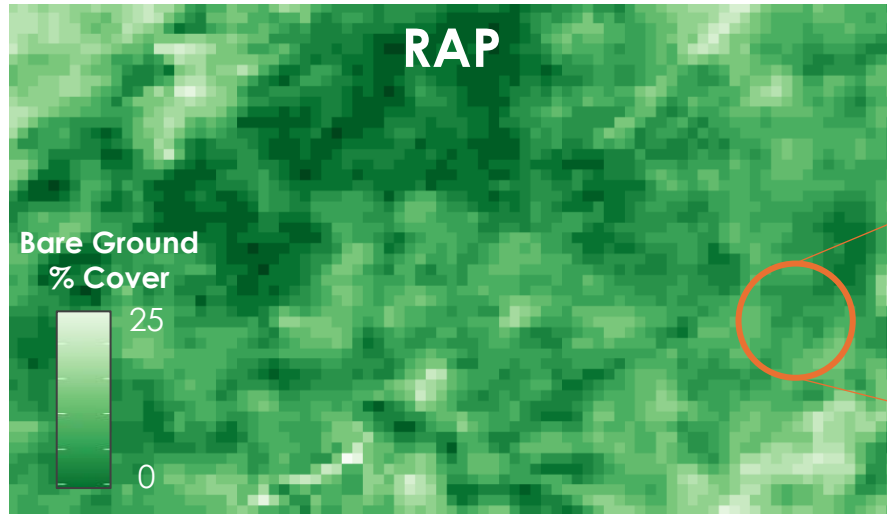
Forbs & Grass



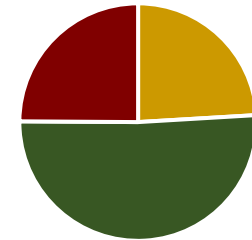
Shrubs



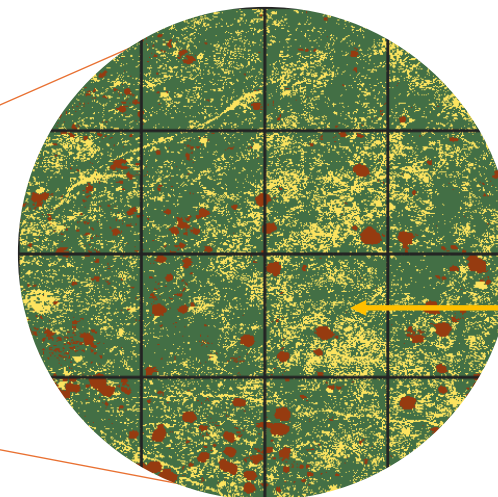
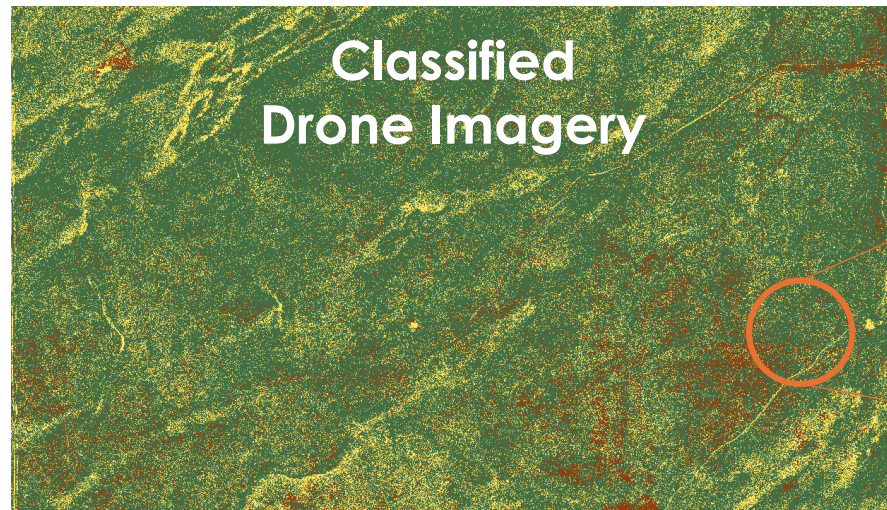
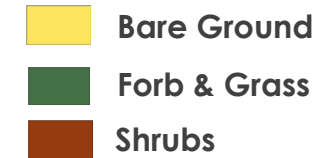
Comparing Drone Imagery to RAP



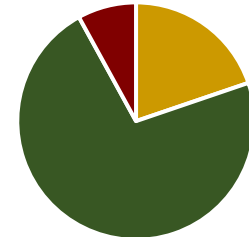
RAP % Cover



Vegetation Classes

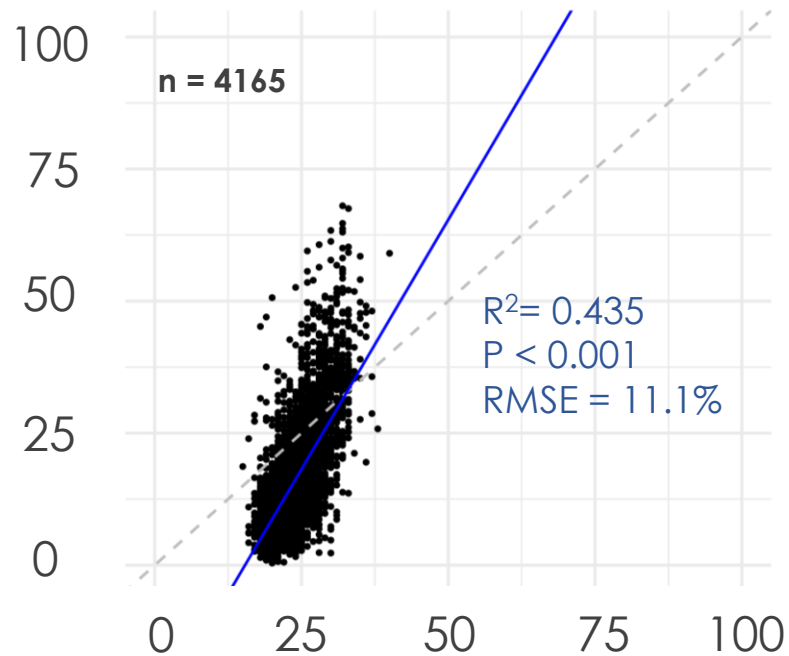


Drone % Cover

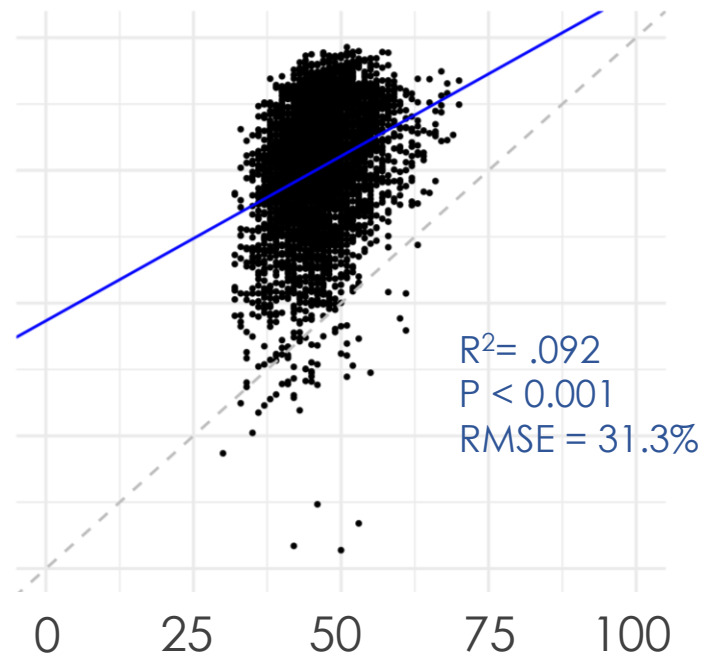


Comparing Drone Imagery to RAP

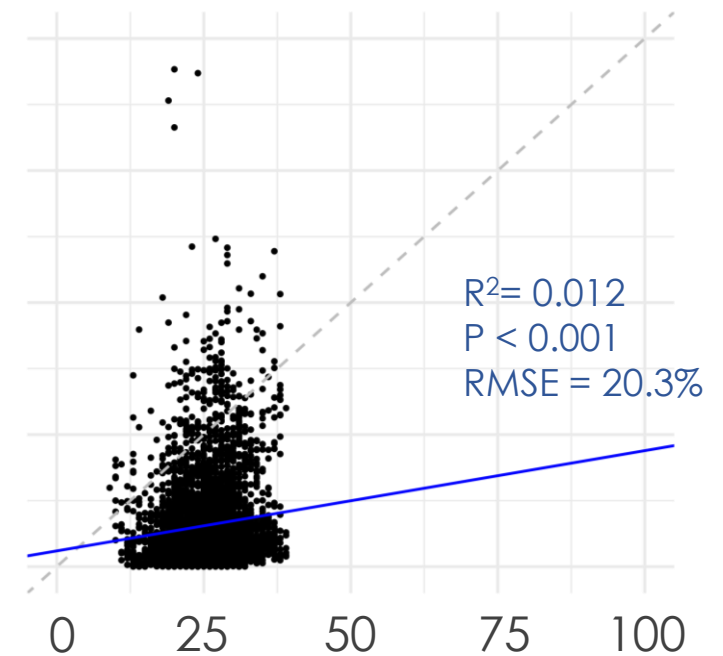
Bare Ground



Grass & Forbs



Shrubs

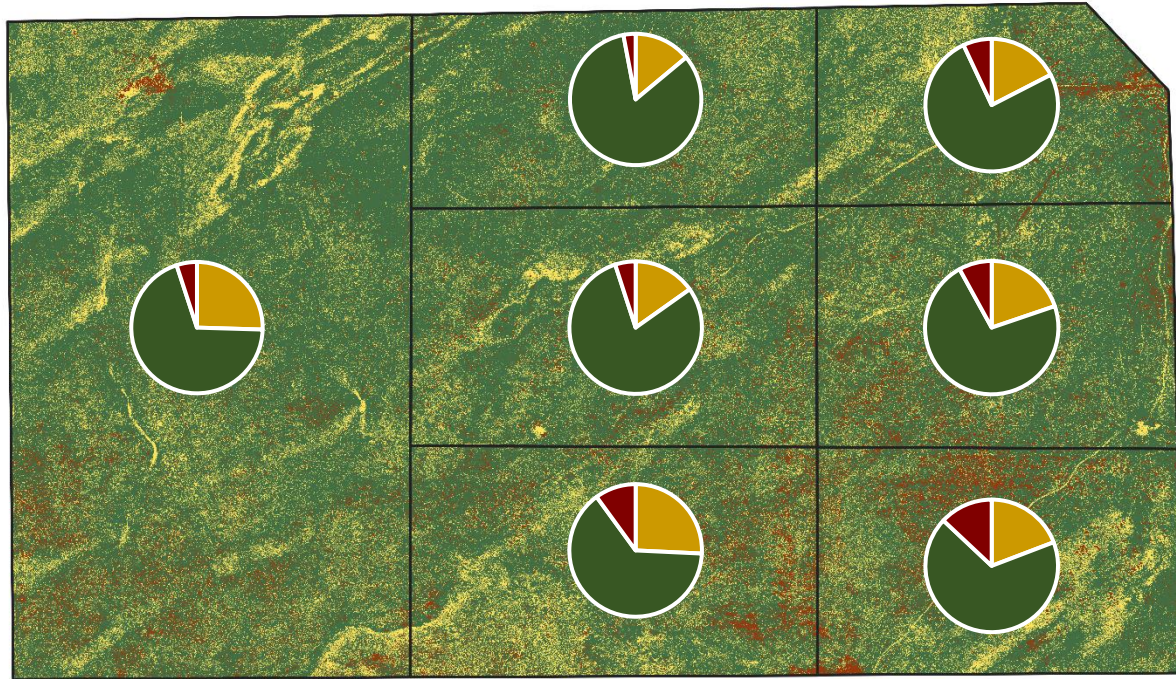


2023 Rangeland Analysis Platform Cover (%)

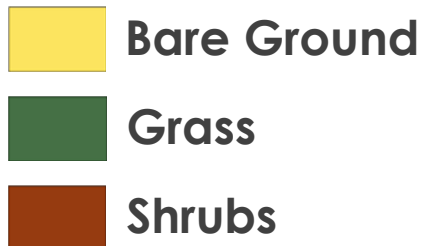
Comparing Drone Imagery to RAP

0 200m

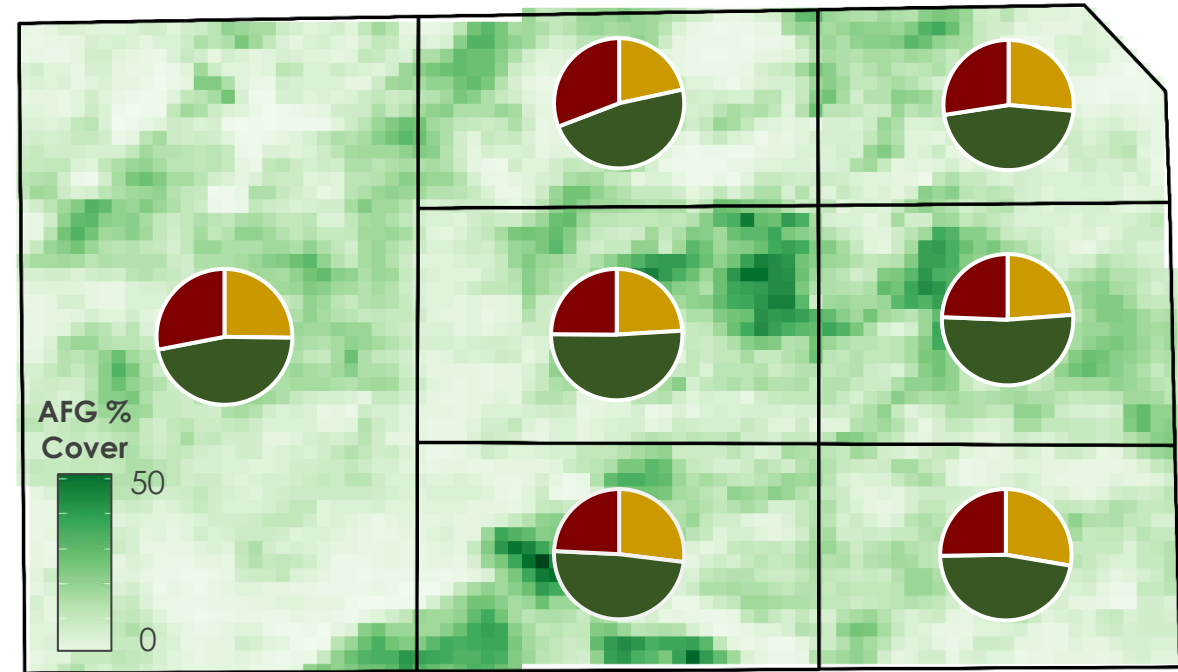
Drone



Vegetation Classes



RAP

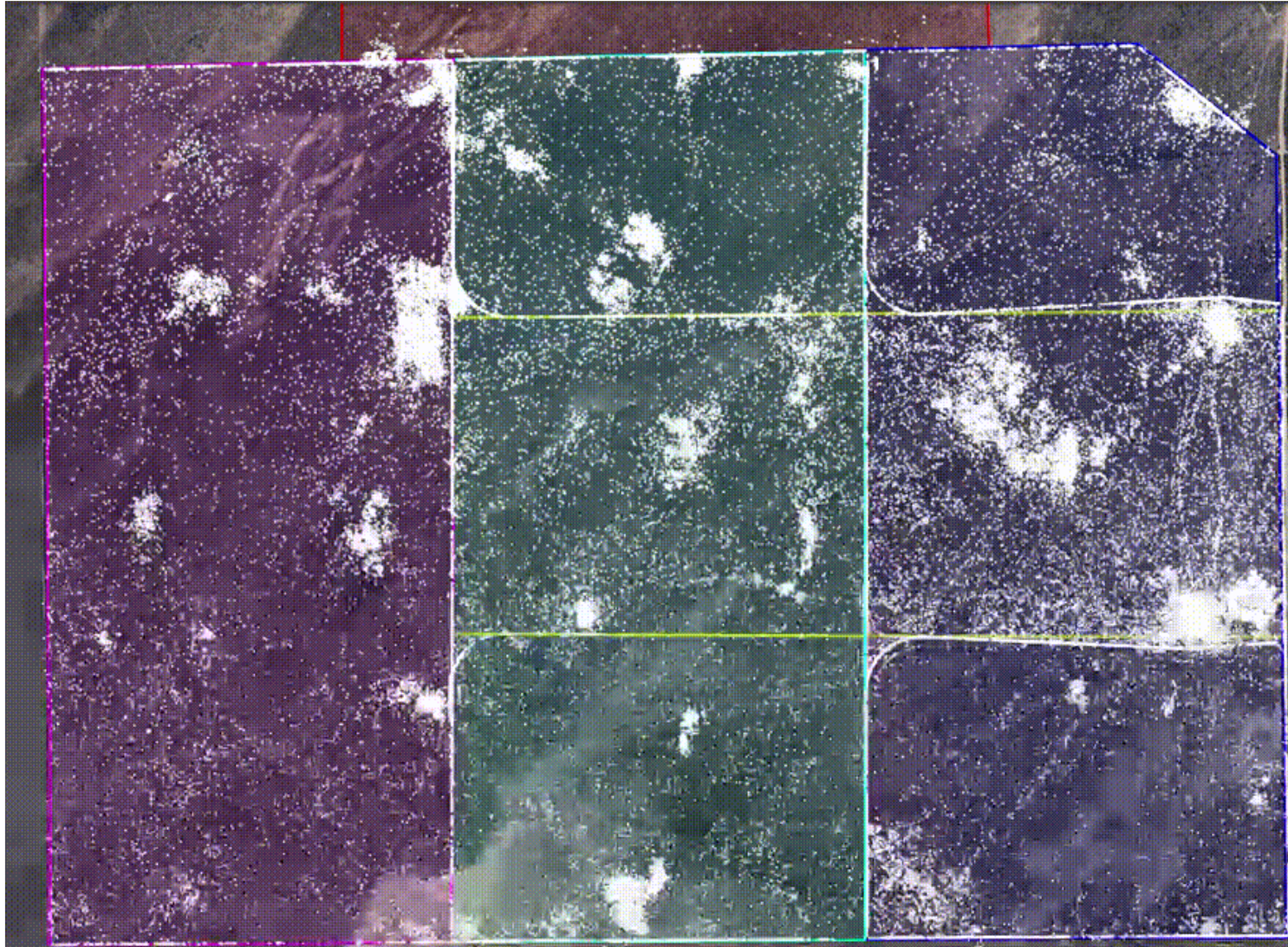


AFG %
Cover

50
0

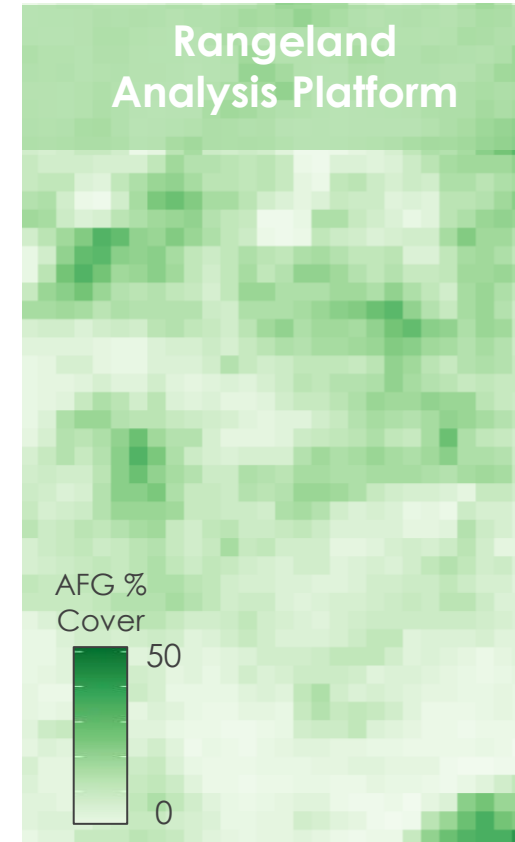
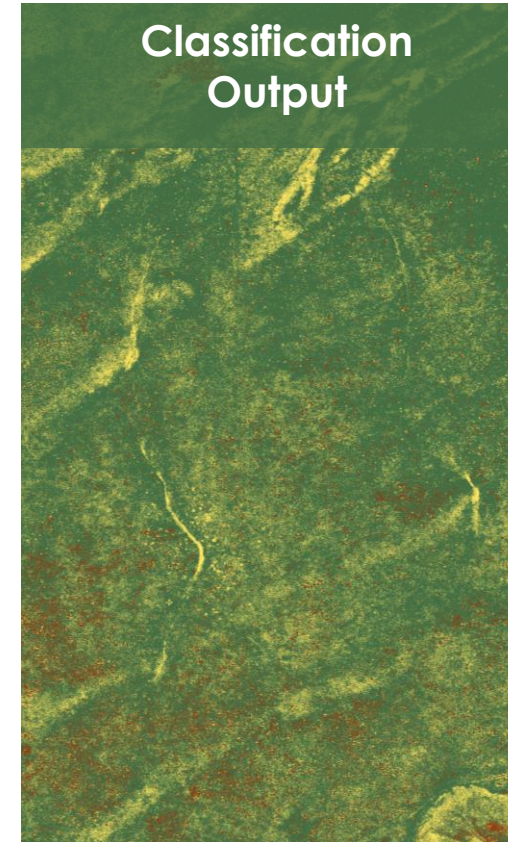
Virtual Fencing Sections

Applications For Virtual Fencing



Limitations

- Spatial alignment of drone imagery and field data
- Comparing 2024 field data to 2023 RAP
- Small sample size of LPI field data
- Timing and size of EMIT data



Conclusions

- RAP has limited accuracy, but is valuable for understanding long term trends in cover
- Drone imagery is useful for mapping plant functional groups
- Comparing drone imagery and RAP illustrates their strengths
- Hyperspectral imagery could provide valuable rangeland monitoring products



Image Credit: Jack Hagenbuch

Acknowledgments

Node Leads

- Truman Anarella
- Kait Lemon

Partners

- Mike and Danna Camblin (Camblin Ranch)
- Tegan May (The Nature Conservancy Regenerative Grazing Lands Strategy)

NASA Acres

Science Advisors

- Nicholas Young
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- Dr. Tony Vorster
- Dr. Catherine Jarnevich
- Dr. Paul Evangelista

Field Crew

- Cameron McLaughlin
- Jack Hagenbuch
- Sage Breck
- Blake Granquist
- Mark Samolej

