Modeling Tallgrass Prairie Above-Ground Biomass in the Central Great Plains Using Ultra-High Spatial Resolution Multispectral Imagery

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EASAL
Ecology & Agriculture Spatial Analysis Laboratory

GEOGRAPHY
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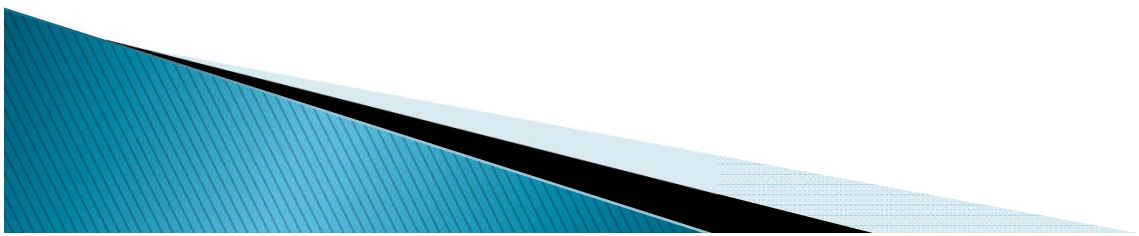
Grassland Biomass

- Above-ground biomass (AGB)
- An important indicator of the grassland ecosystem health.
- It helps estimate livestock yield and biofuel production.
- It is meaningful to soil erosion control.

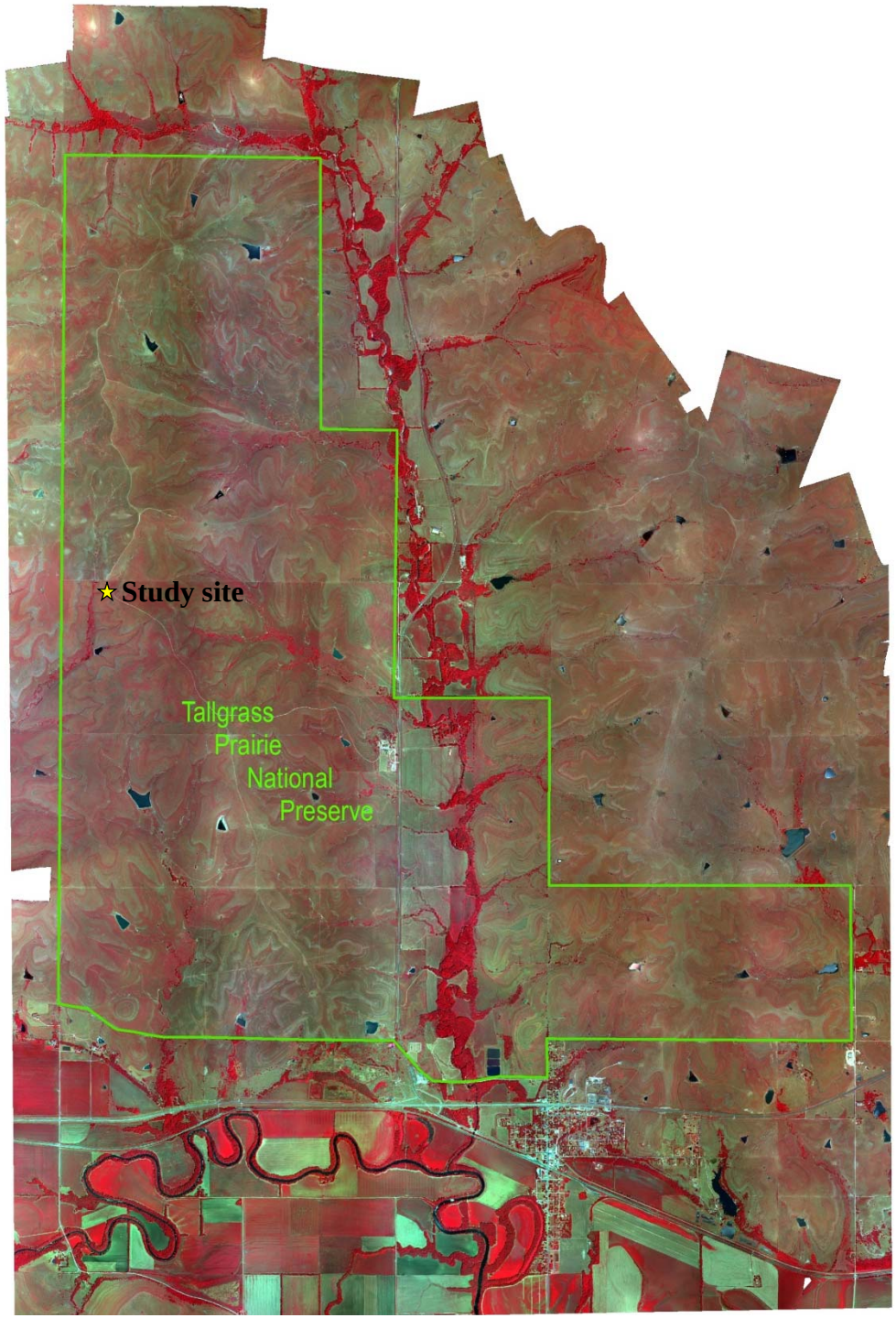



Small Unmanned Aircraft Systems (sUAS)
DJI S800 “Spreading Wings” hexacopter
JDrone hexacopter
Ground station
Radio control
“Ritewing” Zephyr II

Objectives

- To examine the relationship between hyperspatial multispectral imagery taken by our sUAS and tallgrass AGB measurements;

- To evaluate the potential of upscaling sUAS imagery to much coarser spatial resolution satellite imagery to estimate larger area of AGB for a Flint Hills tallgrass prairie type.


Study site
Tallgrass
Prairie
National
Preserve


Plot12
Plot11
Plot10
Plot9
Plot8
Plot7
Grazed
Ungrazed
Plot1
Plot3
Plot4
Plot5
Plot6
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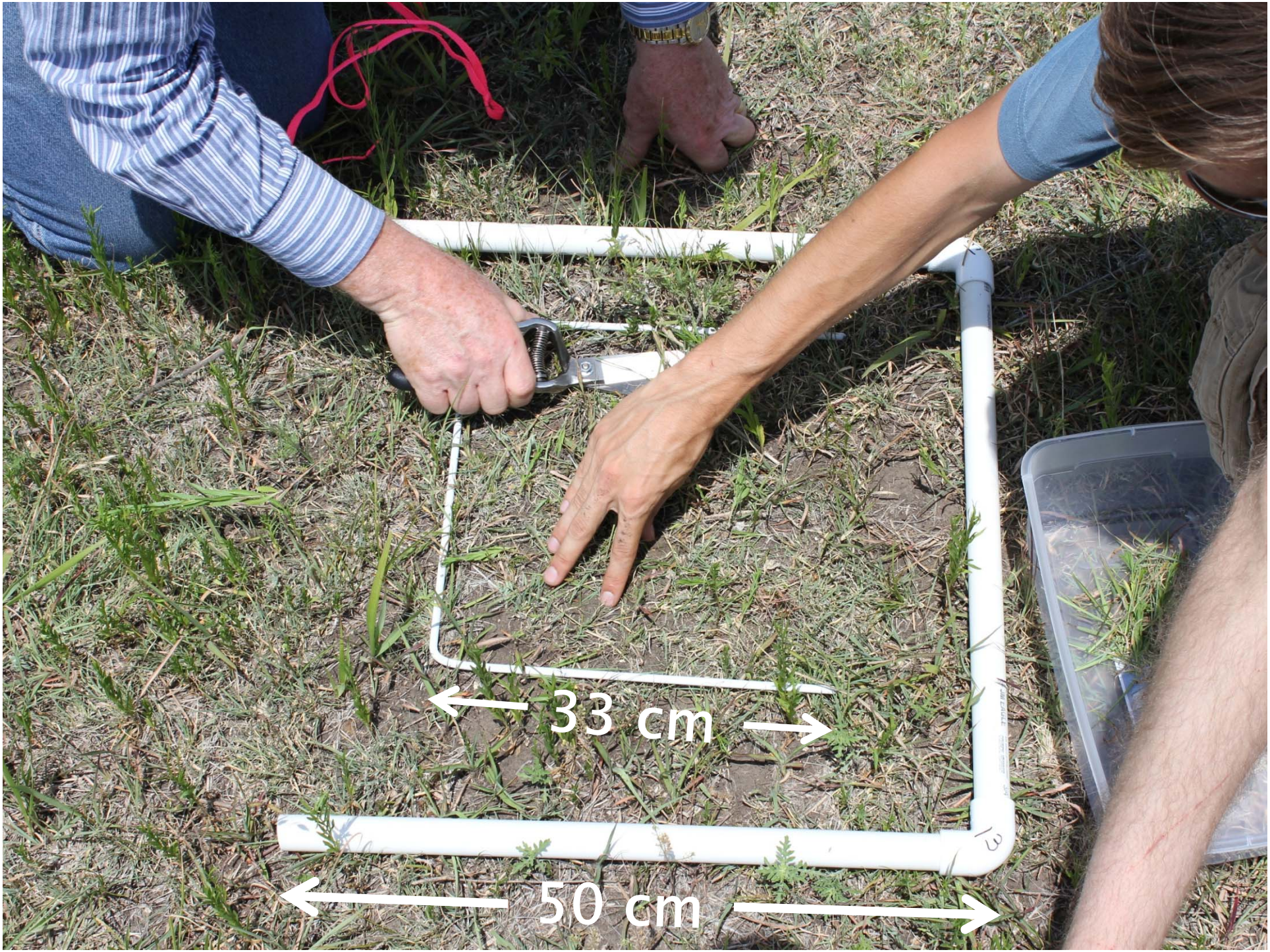
Google earth


33 cm
50 cm

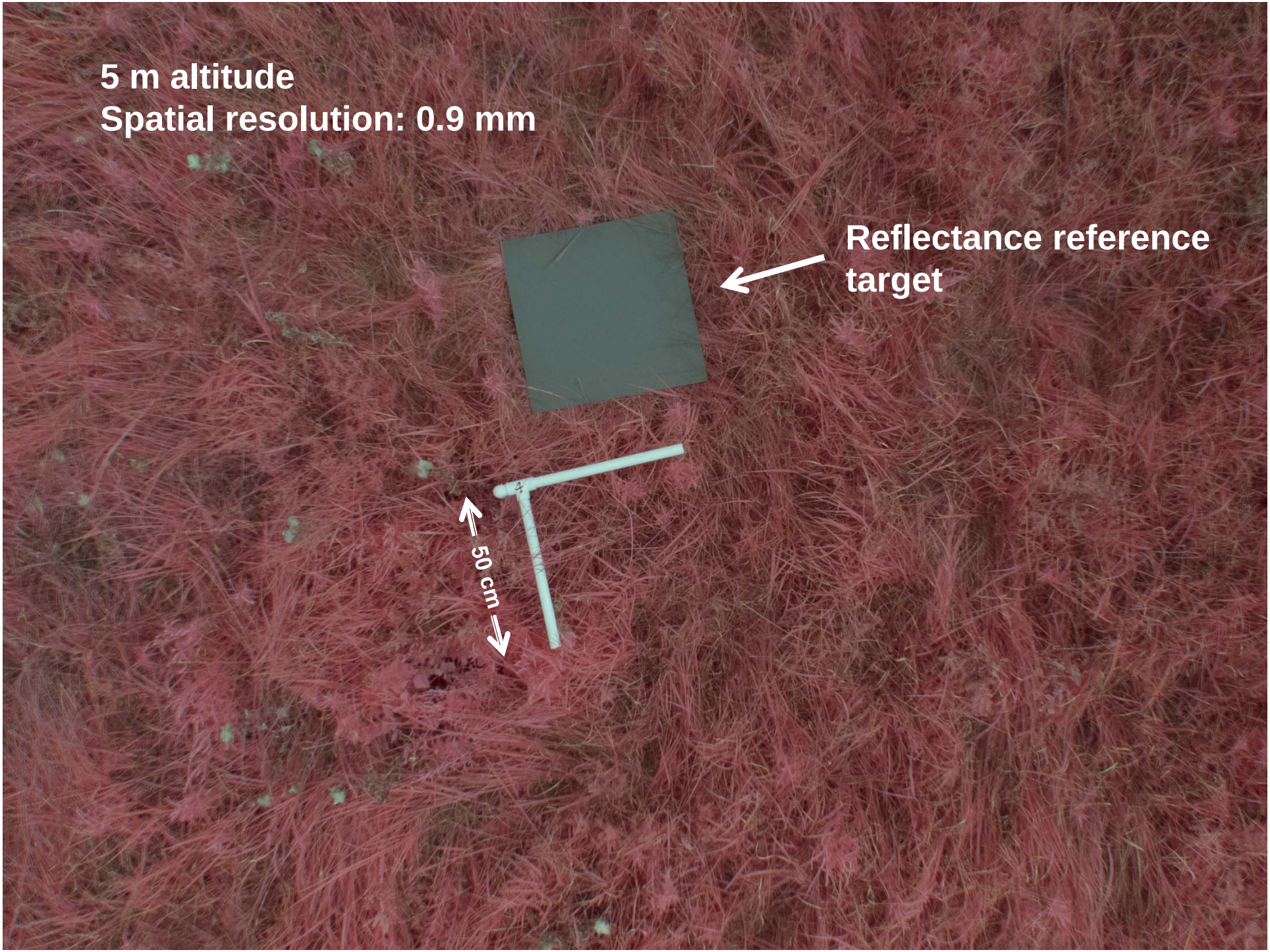
Research Methods

- The first set of color infrared (CIR) digital imagery were collected at each sampling frame location at 5 m above the ground using a modified Canon T4i NDVI camera equipped under the DJI S800 hexacopter.

Canon EOS Rebel T4i

- Modified by LDP LLC-MaxMax
- Bandwidth:

1. Green (500-560nm, peak wavelength @ 550 nm),
2. Red (600-700nm, peak wavelength @ 650 nm),
3. NIR (700-770nm, peak wavelength @ 735 nm).


5 m altitude
Spatial resolution: 0.9 mm
Reflectance reference target
50 cm

Research Methods

- The second and third sets of CIR images were collected at 20 m and 50 m above the ground using the same equipment.


20 m altitude
Spatial resolution: 3.6 mm


50 m altitude
Spatial resolution: 8.9 mm

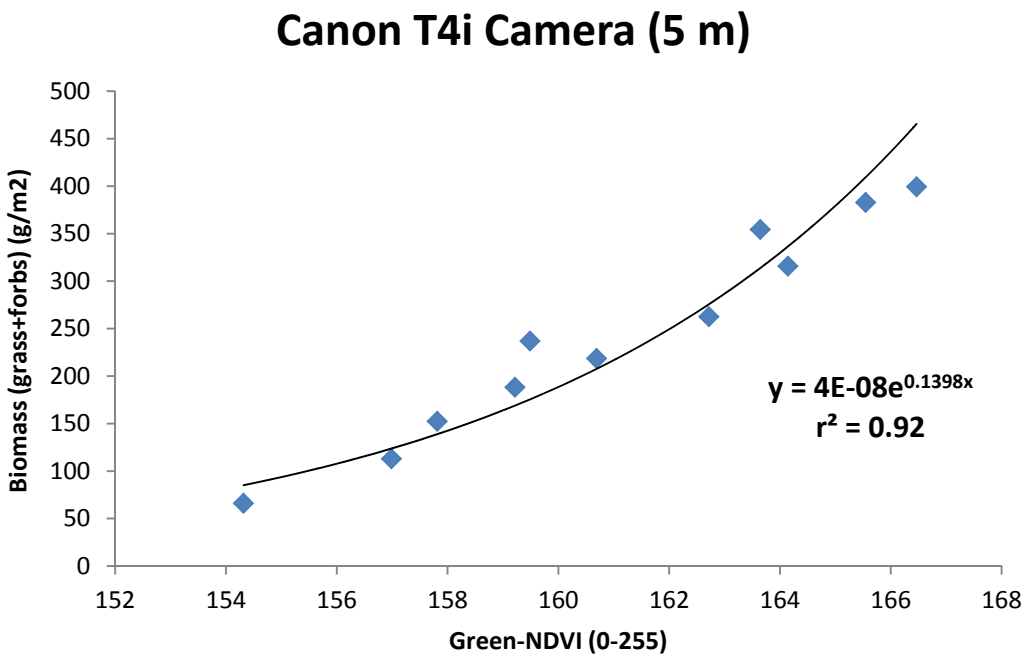
Research Methods

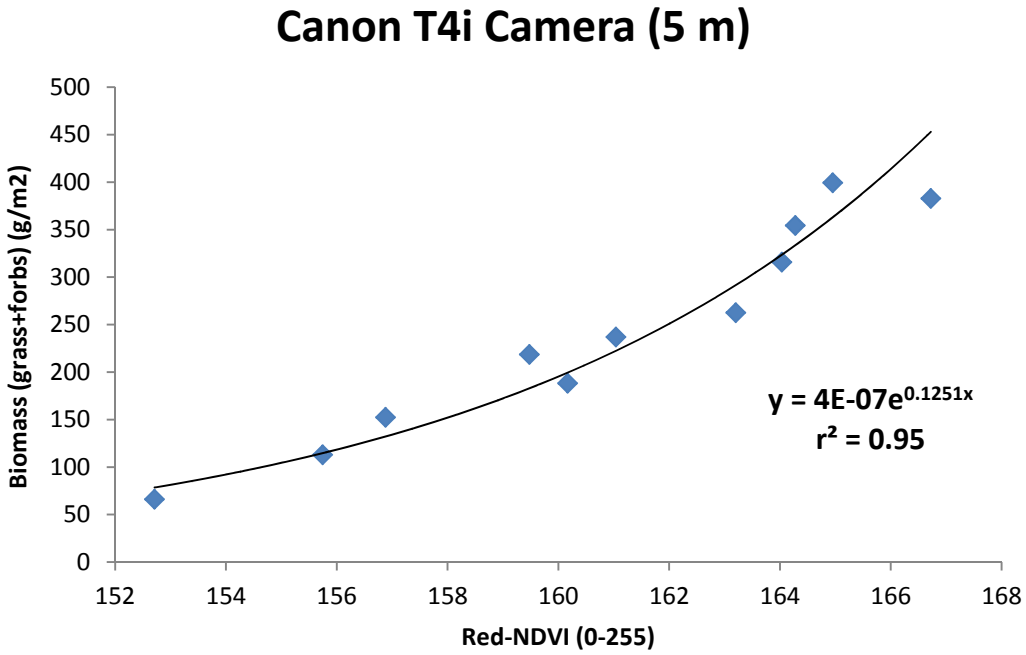
- NDVI (Normalized difference vegetation index)

$$NDVI = \frac{NIR - VIS}{NIR + VIS}$$

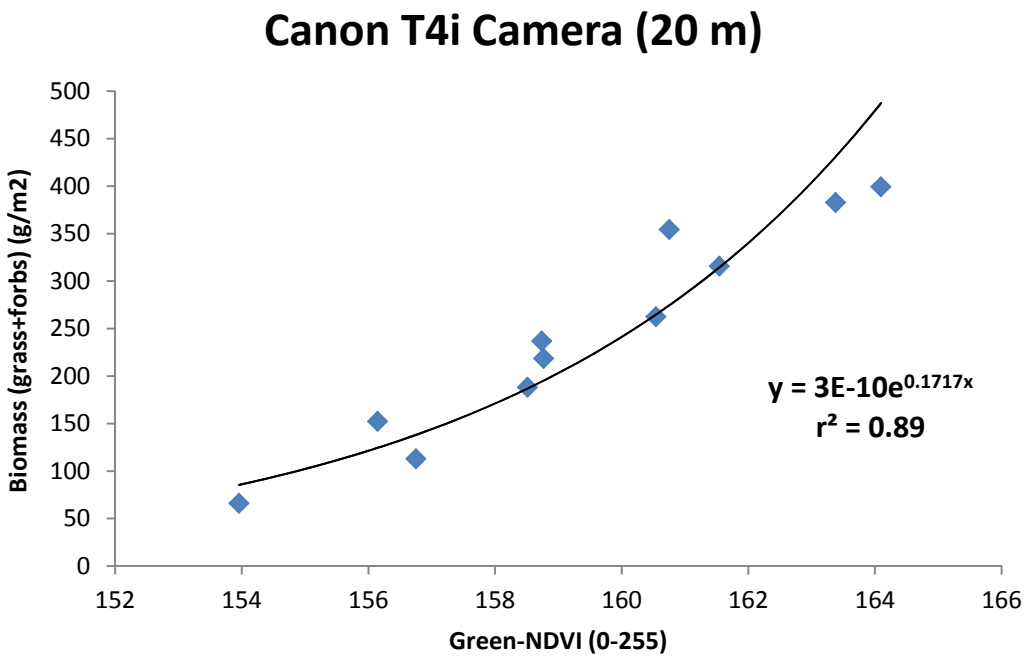
- NDVI values were rescaled to 0-255 and plotted against biomass data.

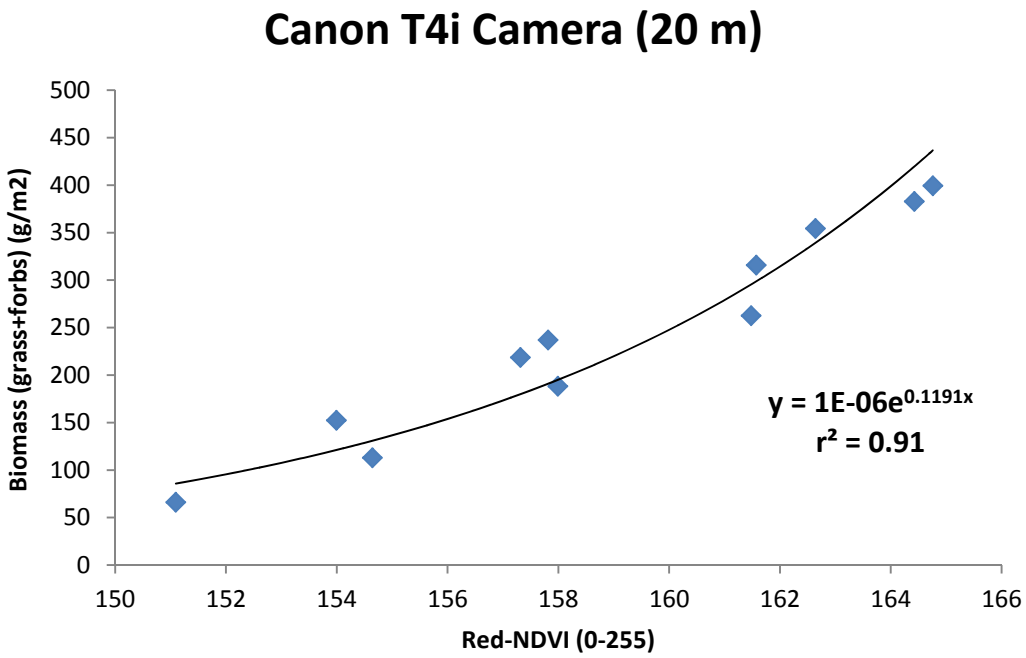
Results



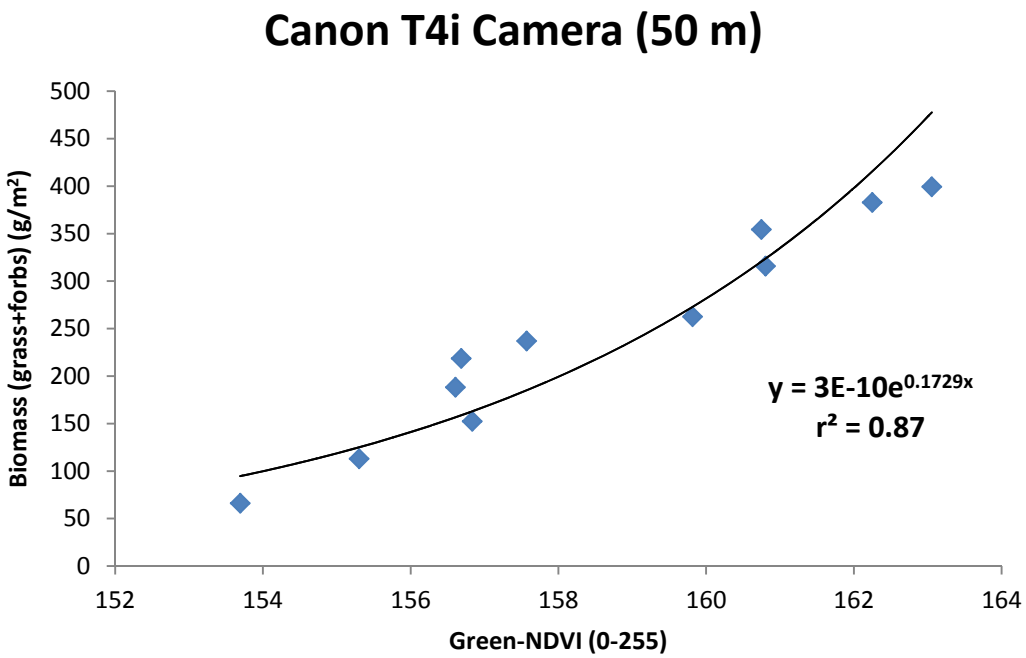


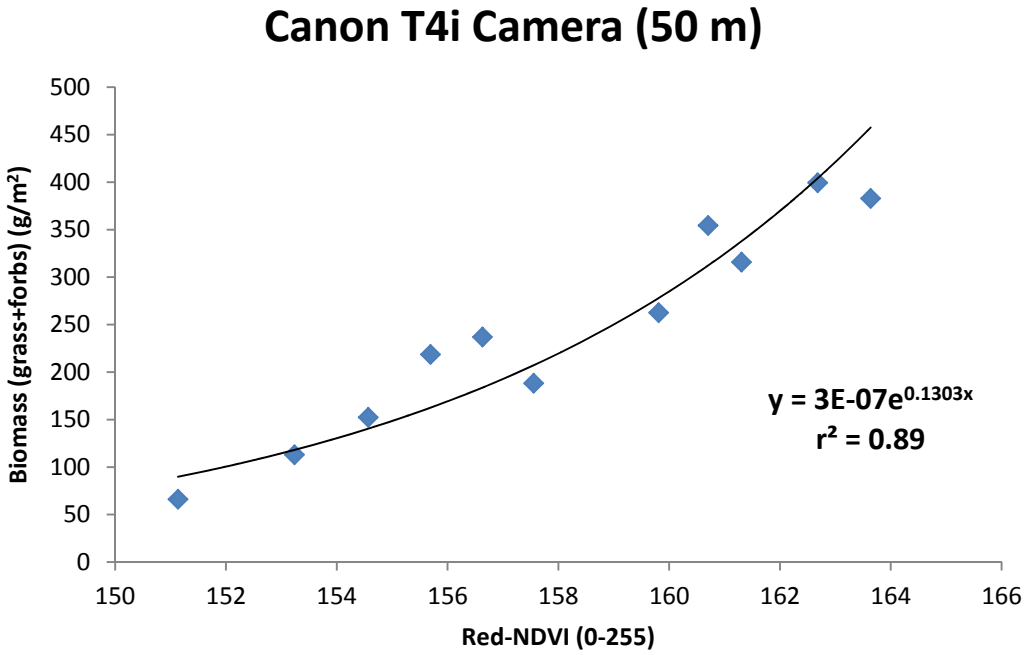
These two diagrams show the relationship between NDVI values and grass biomass for images taken by Canon T4i camera at 5 meter altitude.



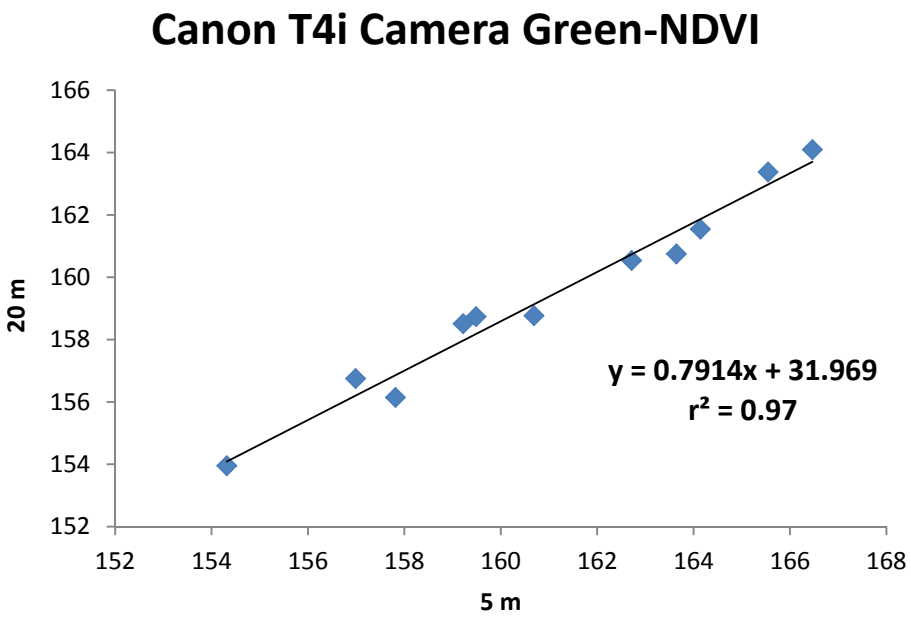


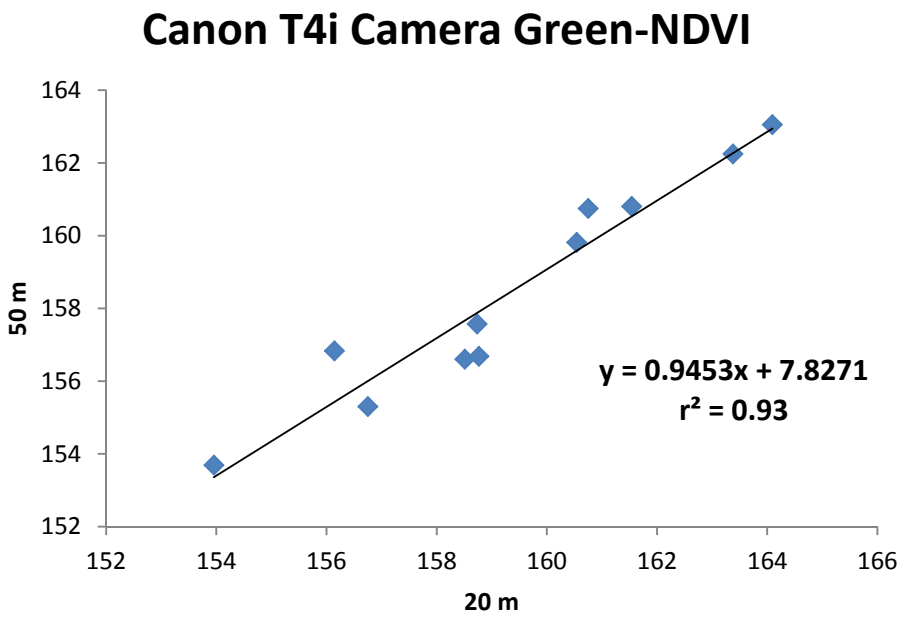
These two diagrams show the relationship between NDVI values and grass biomass for images taken by Canon T4i camera at 20 meter altitude.

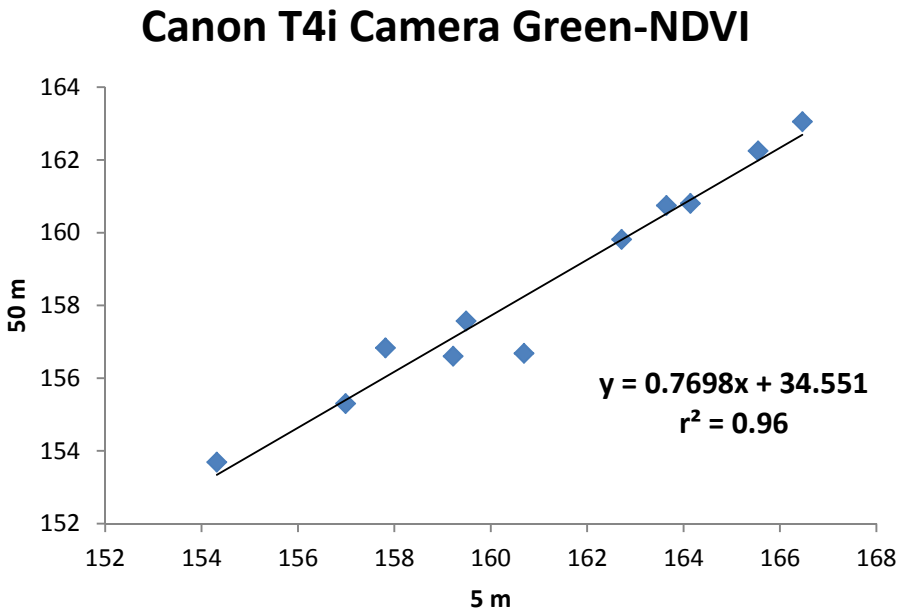




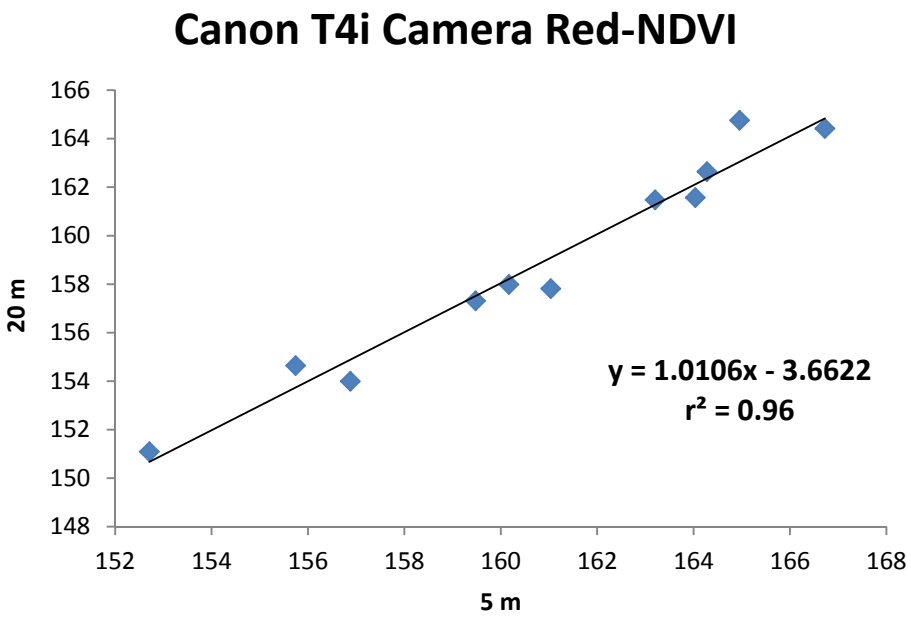
These two diagrams show the relationship between NDVI values and grass biomass for images taken by Canon T4i camera at 50 meter altitude.

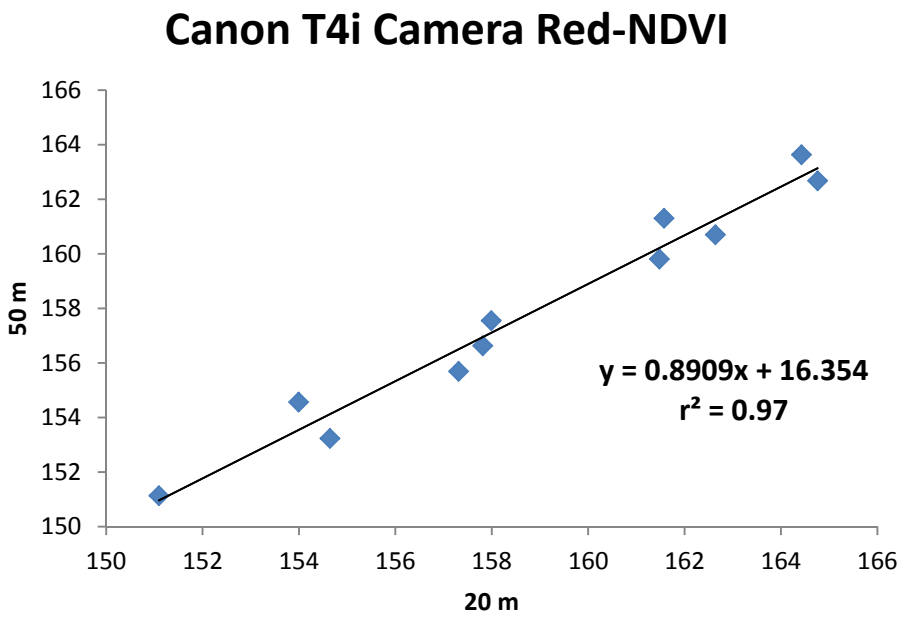


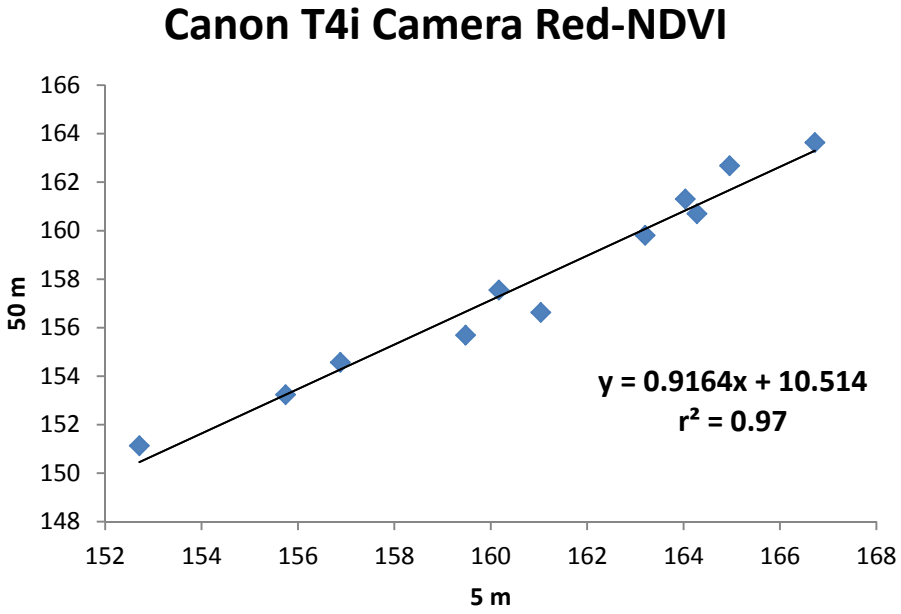




These three diagrams show cross-altitude comparison for Green-NDVI values from imagery collected by Canon T4i camera.





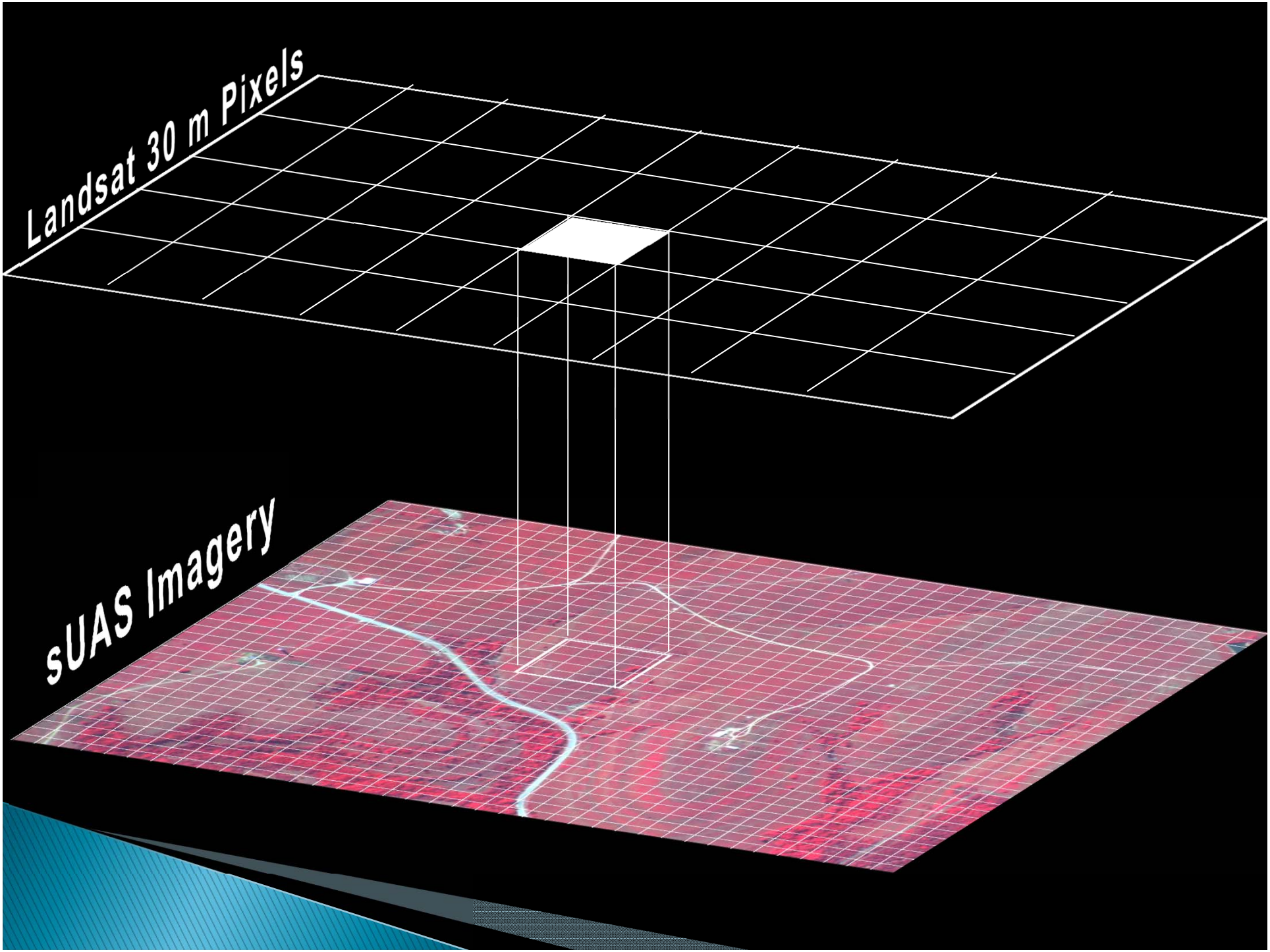


These three diagrams show cross-altitude comparison for Red-NDVI values from imagery collected by Canon T4i camera.

Conclusions

- The spectral data collected can be used to explain significant amounts of variation in dried AGB for a Flint Hills tallgrass prairie type.

- A strong linkage between NDVI values collected from different altitudes suggests these data can be scaled up to provide model estimates of AGB over a larger geographic area.


Landsat 30 m Pixels
sUAS Imagery