COLORADO STATE UNIVERSITY EXTENSION

UAVs IN CROSS-DISCIPLINARY AGRICULTURAL INNOVATION: HIGH-RESOLUTION TOOLS FOR COMPLEX WATER CHALLENGES (MESA COUNTY, WESTERN COLORADO)

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PROJECT INTRODUCTION



Photo by Brett Schreiber

Figure 1. Operating a research drone (DJI Matrice 350 RTK) that collects water-use data as part of a demonstration for the Exploring Colorado Agricultural Systems class.

- Western Colorado agriculture faces drought pressure, Colorado River Basin water constraints, and growing demand for practical irrigation decision support.
- This internship connected UAV-based observations with applied agricultural water-management research.
- High-resolution multispectral and thermal imagery can help detect crop stress and support evapotranspiration (ET) estimation.
- The work linked flight operations, image processing, Python automation, 3D visualization, and Extension communication.

INTERNSHIP GOALS

- Support multispectral and thermal imagery collection for applied irrigation research.
- Build repeatable geospatial workflows in ArcGIS and Python.
- Develop an ET model workflow that connects imagery, field observations, and crop water-use questions.
- Prepare outputs for Extension communication and future AI-enabled irrigation tools.

NEXT STEPS

- Refine ET-model assumptions and compare outputs with available ground-based observations.
- Use maps, figures, and 3D visualization to communicate crop-stress and irrigation findings to Extension and producer audiences.

WHAT I LEARNED

- Python automation improves reproducibility, reduces manual processing time, and helps standardize image-analysis workflows.
- ET modeling requires careful integration of spatial imagery, ground observations, meteorological context, and crop conditions.
- 3D visualization can make a field station easier to understand for researchers, producers, and Extension audiences.
- Thermal and multispectral imagery provide complementary perspectives on crop water stress and field variability.
- Extension work requires translating technical geospatial outputs into practical information for producers and partners.

CSU Western Colorado Research Center (3D model)



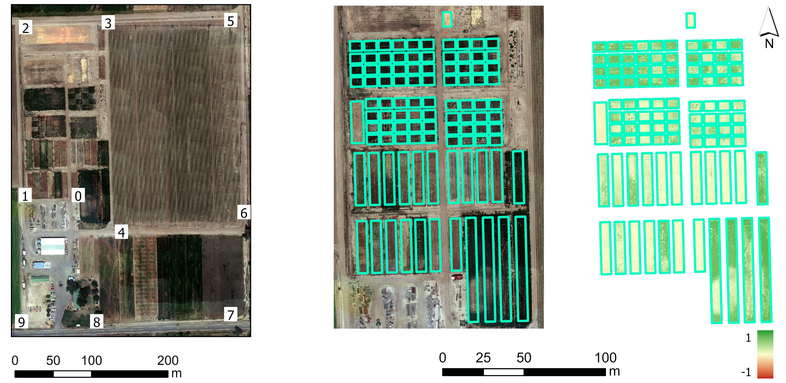
Date: August 13, 2026 Credits: Douglas Dean, Kateryna Bakova

Figure 2. 3D visualization of landscapes and structures at the CSU Research Center in Western Colorado (Grand Valley) using the Gaussian Splatting method.

HOW DOES THIS APPLY TO MY EDUCATION

- This internship strengthened the link between my graduate training in ecology and applied remote sensing for water-limited landscapes.
- It built on my GIS background while expanding my skills in Python automation, ET modeling, and UAV-derived spatial analysis
- The experience helped me translate complex geospatial data into products useful for real-world decision-making in agriculture and Extension.

WHAT I DID



a) b)

Figure 3. Process of determining NDVI characteristics for the study plots.
a) Orthophoto of the Western Colorado Research Center with established ground control points (GCPs) for the georeferencing of drone imagery; b) Boundaries of the study sites (100 plots) defined and NDVI values determined for each plot.

Calculating NDVI statistics for individual plots

Plot...	Pixel_Count	Mean_NDVI	Median_NDVI	SD_NDVI	Min_NDVI	Max_NDVI	Range_NDVI	Kurtosis	Shape_Length	Shape_Area
23-1	24415	0.558406	0.62717	0.178628	-0.106595	0.769096	0.875691	1.895938	26.663529	43.82323
23-2	24422	0.643157	0.668443	0.089021	0.07214	0.76914	0.697	7.905562	26.663529	43.82323
23-3	24414	0.578165	0.623804	0.12986	-0.01602	0.756985	0.773005	2.403234	26.663529	43.82323
23-4	24414	0.573535	0.642666	0.17149	-0.073091	0.755387	0.828478	1.896521	26.663529	43.82323
24-1	24414	0.641103	0.66933	0.094019	0.04663	0.773389	0.726758	5.622799	26.663529	43.82323
24-2	24417	0.589491	0.653629	0.158543	0.011964	0.768949	0.756986	1.266923	26.663529	43.82323
24-3	24420	0.64238	0.683046	0.115918	0.004861	0.773081	0.76822	5.839878	26.663529	43.82323
24-4	24414	0.590842	0.651862	0.152929	-0.027077	0.767909	0.794986	1.872909	26.663529	43.82323

Table 1. Example of calculating statistical metrics for individual plots for June 22, 2026.

- Supported UAV data workflows for Western Colorado agricultural research, including image organization and field-data management.
- Processed multispectral imagery in Drone2Map and addressed radiometric calibration questions using MicaSense panel reflectance values.
- Wrote Python scripts for ArcGIS Pro to automate repeatable geoprocessing steps for UAV-derived spatial products.
- Updated an ET model workflow to connect high-resolution aerial observations with crop water-use analysis.
- Prepared processed outputs for NDVI, thermal, spatial summaries, and map-based interpretation.
- Executed a 3D flyover of the research station to support site visualization, project communication, and future outreach.