Precision Agriculture

Project Case Study #2

Work with Chris

Project Case Study

The Rutgers Center for Turfgrass Science boasts a distinguished history of research, education, and service programs in support of the turfgrass industry since 1923. With over 100,000 individual trial plots to monitor each year, the farm wished to leverage UAS (drones) and GIS (Geographic Information Systems) to modernize & enhance its research operations.

AlphaRTK was engaged to:

- Create a simple, scalable UAS workflow
- Automate multispectral index extraction to GIS
- Digitize paper-based researcher workflows
- Develop dashboards for data visualization & analysis

The Challenges

- 100,000+ individual plots and plants to monitor
- Paper/Excel based field observations
- Hand-held NDVI meter
- Needed scalable solution
- No GIS analysis

The Solutions

- **ArcGIS Field Maps** for field observations
  - Converted excel into smart forms
- Multispectral UAS weekly data collection
- Automated index extraction to GIS
  - NDVI
  - NDRE
  - GLI (green leaf index)
- **ArcGIS Experience** website + dashboards

The Technology

Farm staff & researchers did not wish to be tripped up by the technology. AlphaRTK selected the **DJI Mavic 3 Enterprise Multispectral** for its:

- Ease of use
- Co-registration of aerials + multispectral indexes
- Low price point
- RTK positioning capability

To process photogrammetry, **Pix4D Fields** was chosen for its:

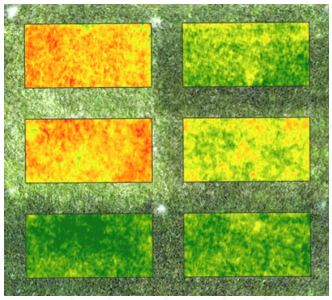
- Simplicity of user-interface / workflow
- Off the shelf indexing abilities
- Custom indexing abilities
- Processing speed
- Low price point

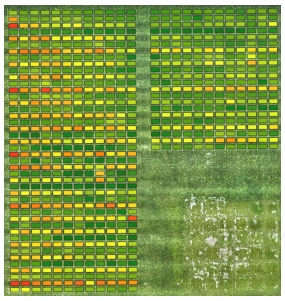
Plot Trial Extraction

Drone flights capture a lot of data and researchers are only interested in data statistics within tiny plot trials.

The use of the AlphaRTK network precision ensured spatial accuracy consistency from flight to flight.

GIS tools were then utilized to extract only plot trial values.





Plot Trial Basic Spatial Statistics

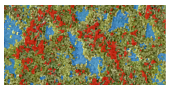
Next, more GIS tools were utilized to extract & calculate:

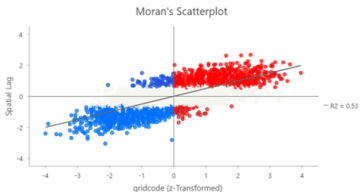
- Mean index value for each plot trial
- Z-score for each plot trial

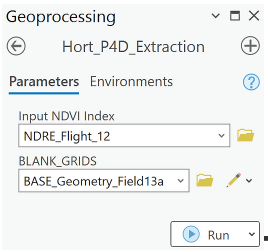
Advanced Spatial Statistics

Spatial Auto-correlation techniques utilized to:

- Objectively rank "uniformity" ratings
- Baseline subjective ratings made by researchers
- Improve researcher training



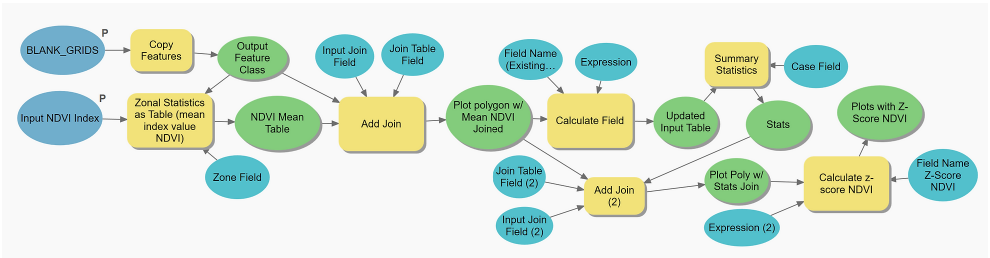




Automation

The extraction process for each index was automated with geoprocessing tools which:

- Eliminated dozens of steps for researchers
- Reduced opportunities for error
- Lowered learning curve

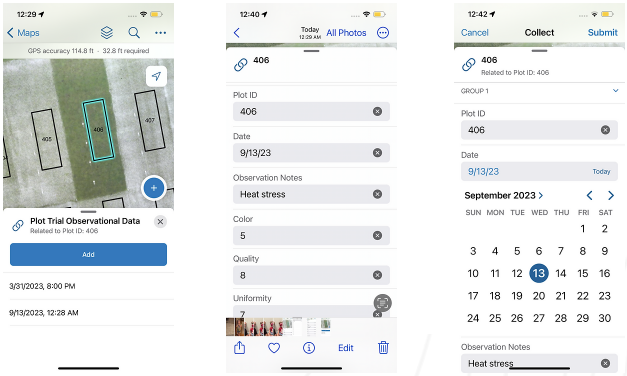


Modernizing Manual Researcher Observations

Researchers were still using pen & paper to field document subjective quality rankings. These rankings were then transferred to excel manually.

Plot No.	Rep	Column	Trt No.	Sand Size	Sand Rate	Cultivatio	Greenp-up after 1st mow 2023 04 01	Quality 2023 04 26	healing core holes 2023 04 26	color 2023 04 26	healing core holes 2023 05 10	Quality 2023 05 10	color 2023 05 10	healing core holes 2023 05 27	Quality 2023 05 27	color 2023 05 27(may be subtract 1 from all?)	healing tine holes 2023 06 11	residual sand 2023 06 11	quality 2023 06 11	healing tine holes 2023 06 24	residual sand 2023 06 24	quality 2023 06 24	healing tine holes 2023 07 07	residual sand 2023 07 07	quality 2023 07 07	residual sand 2023 07 15	quality 2023 07 15
101	1	1	10	FM	50	Yes	4	5	75	6	90	6	5	98	7	6	50	5	5	80	9	6	100	9	8	9	7
102	1	2	12	FM	100	Yes	5	6	90	6	95	7	6	100	8	7	60	6	6	95	9	8	100	7	7	9	8
103	1	3	5	MF	50	No	6	8		7		9	7	98	9	8		5	7		9	8		9	9	9	8
104	1	4	2	MC	50	Yes	3	6	80	5	90	6	6	100	7	7	50	6	5	90	9	7	100	9	8	9	8

AlphaRTK recognized this as an "inspection" process and implemented an **ArcGIS Field Maps** form-driven workflow.



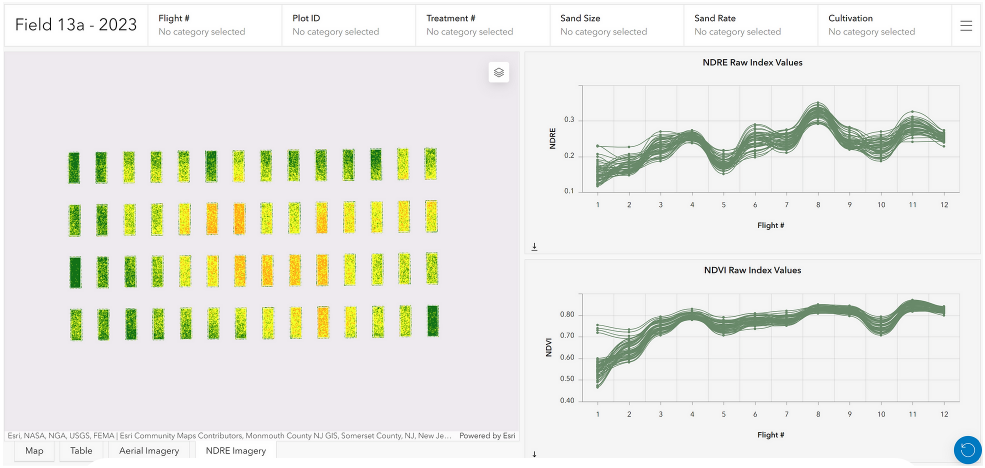
Bringing it all Together

All farm research data (UAS, GIS statistics, Field Observations) are stored in hosted ArcGIS feature classes. These were assembled into an ArcGIS Experience website which contains:

- Master GIS map of farms
- Field infrastructure (field names, irrigation, sensors, etc.)
- Dashboard links for individual fields / seasons

Dashboards contain:

- Filters for various attributes (Plot ID, Treatment, Phenotype, Trial, Rep, Sand Rate, etc.)
- Charts showing multispectral index trends (interactively controlled via filters)
- Downloadable tables for all seasonal observations
- Color aerial imagery for each flight
- Multispectral imagery for each flight
- Color-coded statistics map (means, z-scores, etc.) for each flight



The research insights and operational efficiencies provided by this project have proven invaluable to Rutgers University. The school has decided to move forward with scaling this project to its full farm operations.

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Alpha RTK

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