Virtual workshop series:
Water Resource Management and Irrigation in Kansas

Natural Resources PFT

Kansas Center for Agricultural Resources and the Environment (KCARE)

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Theme 3: Water Resource Management and Irrigation in Kansas

- Offered as a Professional Development Event in PEARS for county extension agents

- 5 sessions in March and April, 8:30 am to 9:30 am
  - The next session is *April 8, 2021*

- **Zoom Meeting ID: 952 6066 1935**

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Today's format

- Please **mute** microphones and sign in using the chat.
- Speakers will present for 30-40 minutes
- Panelists will join the discussion at the end
- Please ask questions through the **chat** function (located at the lower part of your screen).
- Although our "end time" is posted for 9:30 a.m., participants are welcome to remain longer if they want to discuss the topic further.

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Water Resource Management and Irrigation in Kansas

Innovative water management technologies

Wednesday, March 31, 2021

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Speakers

Andres Patrignani
Department of Agronomy,
Kansas State University

Jeff Davidson
Watershed Specialist,
KCARE

Ray Flickner
Flickner Innovation Farm
Moundridge, Kansas

Panelists

Rick Schlender, Sand-D-Akr Farms Consulting

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Revealing Field-scale Soil Moisture Spatial Variability to Guide the Deployment of Moisture Sensors

Andres Patrignani[1] and Pedro Rossini[1] in collaboration with Ray and Ryan Flickner[2]

[1]Soil Water Processes Lab - Department of Agronomy
[2]Flickner Innovation Farm

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Questions

1. How many soil moisture sensors are required to characterize a given field?
2. Where do we place a limited number of soil moisture sensors?
3. Accuracy of research-grade vs consumer-grade sensors
4. How can we improve in-season management decisions based on current soil moisture and canopy conditions?

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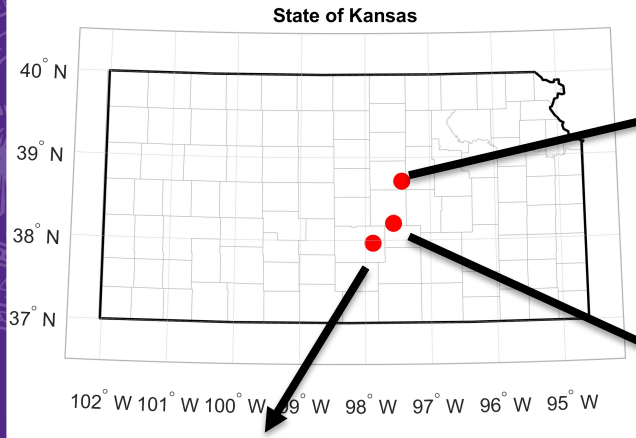
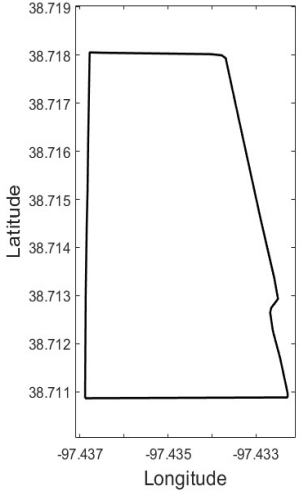
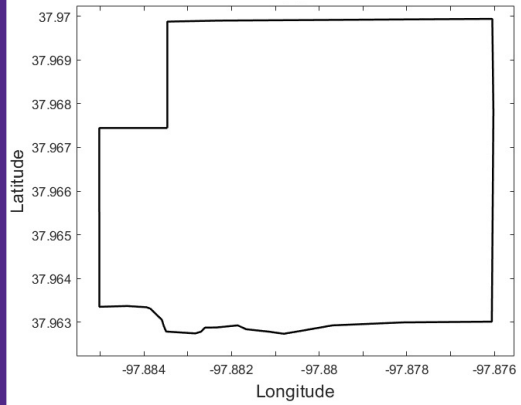
Experimental Sites

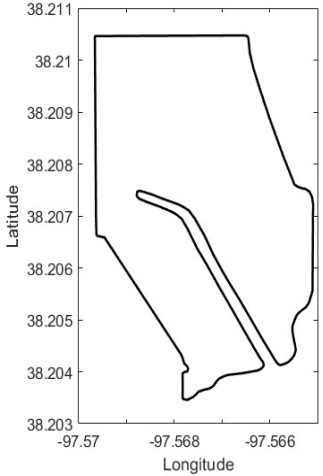




Season: 2017
Location: Gypsum
Area: 28 ha
System: Rainfed



Season: 2018
Location: Hutchinson
Area: 58 ha
System: Irrigated



Flickner Innovation Farm
Season: 2019
Location: Moundridge
Area: 22 ha
System: Irrigated

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Field Data Collection

- Total of 6 soil moisture surveys during the fallow period
- Hand-held sensor with 12-cm rods
- Collection of volumetric water content (%) along with geographic coordinates
- A total of 1200 soil moisture measurements

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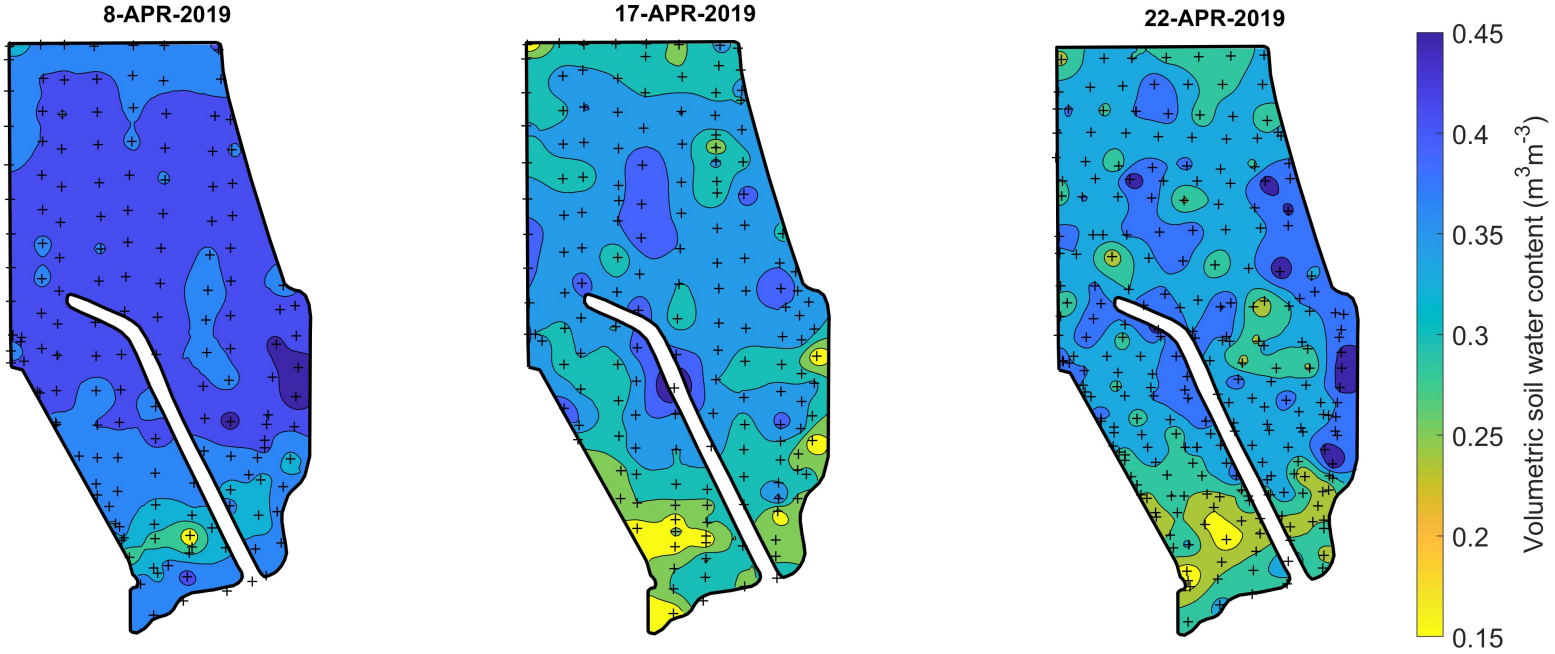
Soil moisture spatial variability



Wetter condition

Drier condition

CV = 7%

CV = 13%

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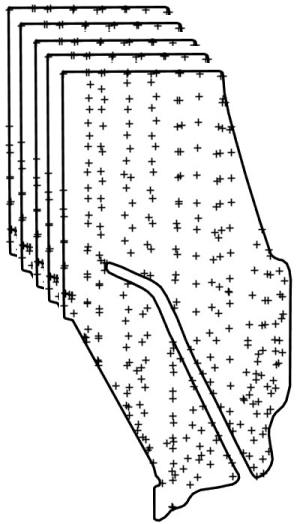
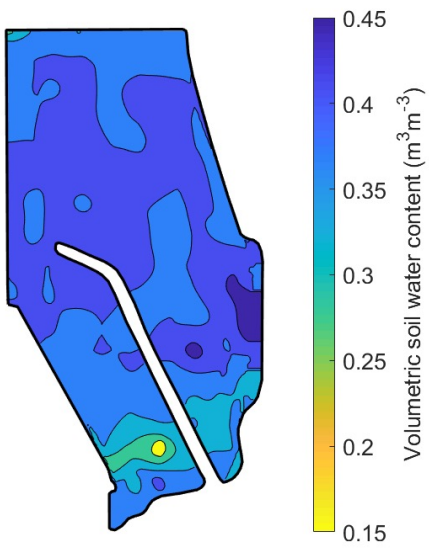
Data Analysis Workflow

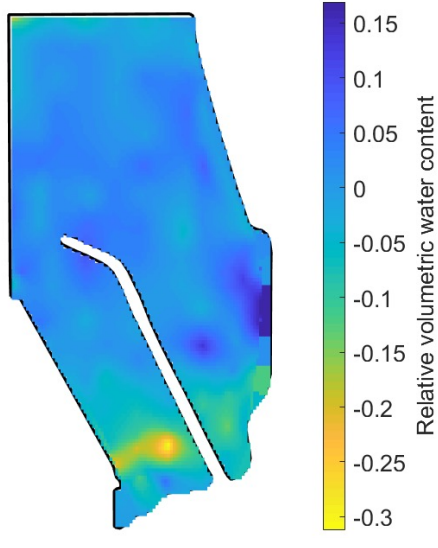
Soil Moisture Surveys



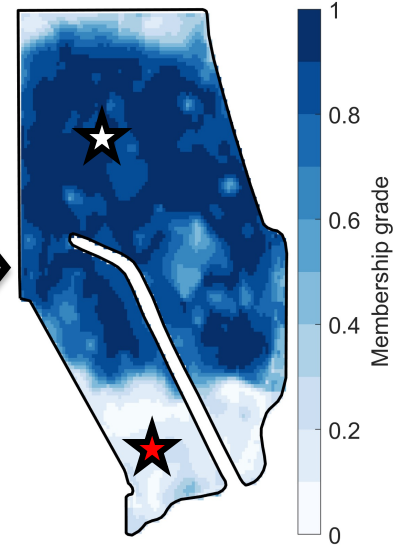
Data Interpolation



Normalization



Clustering



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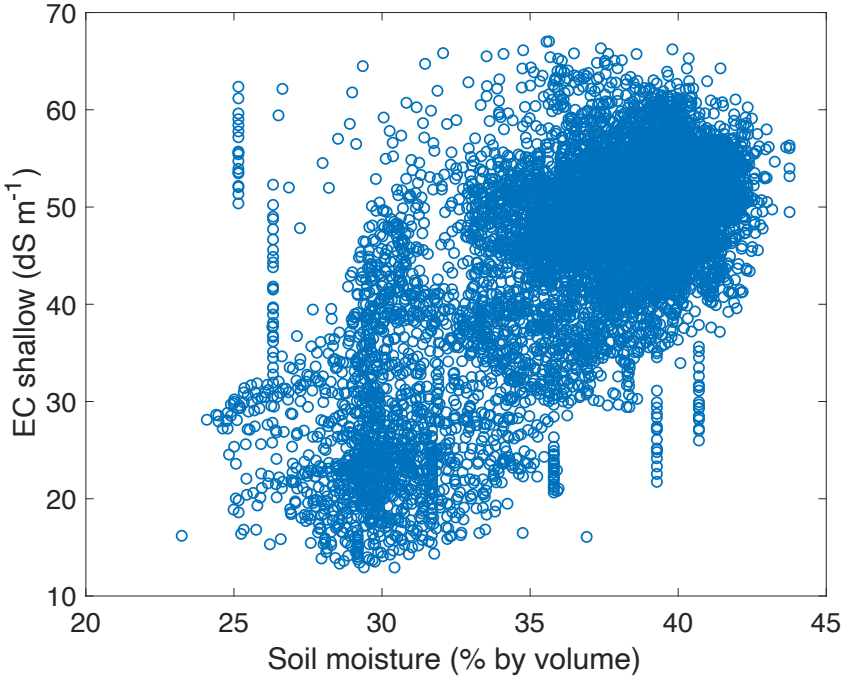
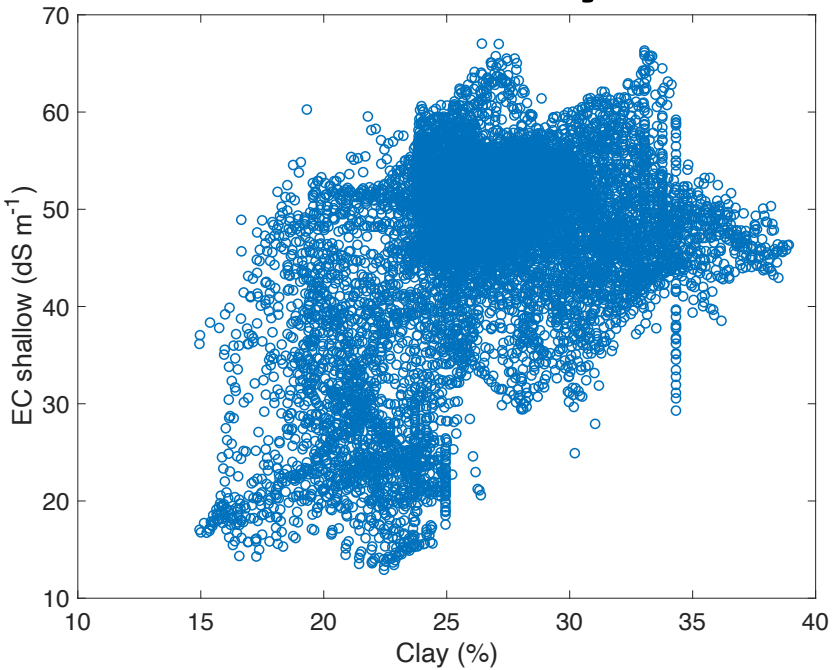
EC vs Soil moisture



EC vs Clay

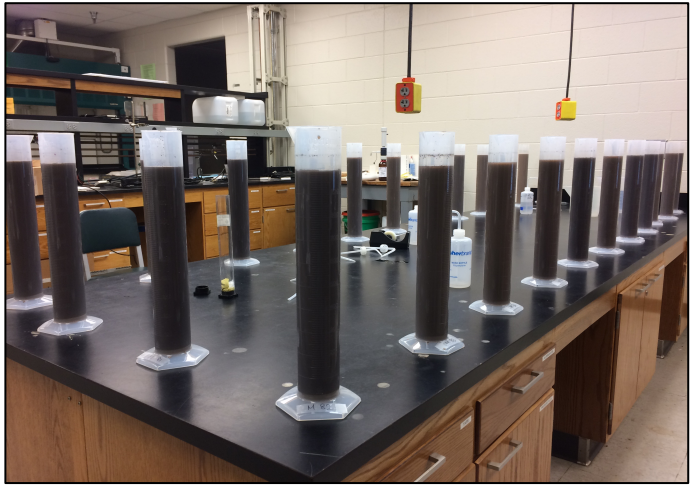


Multiple surveys of electromagnetic soil mapping are required to accurately capture soil moisture spatial variability using this technique**.** García, G. M., Vanderlinden, K., Pachepsky, Y., Cervera, J. V. G., & Pérez, A. J. E. (2012). Estimating Topsoil Water Content of Clay Soils With Data From Time-Lapse Electrical Conductivity Surveys. Soil Science, 177(6), 369–376. https://doi.org/10.1097/SS.0b013e31824eda57

Soil Physical Properties

- Soil texture by the Hydrometer method (Gavlak et al., 2003)
- Samples collected at 12 cm depth (>100 samples)

- Soil water retention curve
- Samples collected at 5 cm depth
- Hyprop 2 (Meter Group Inc.)
- WP4C (Meter Group Inc.)



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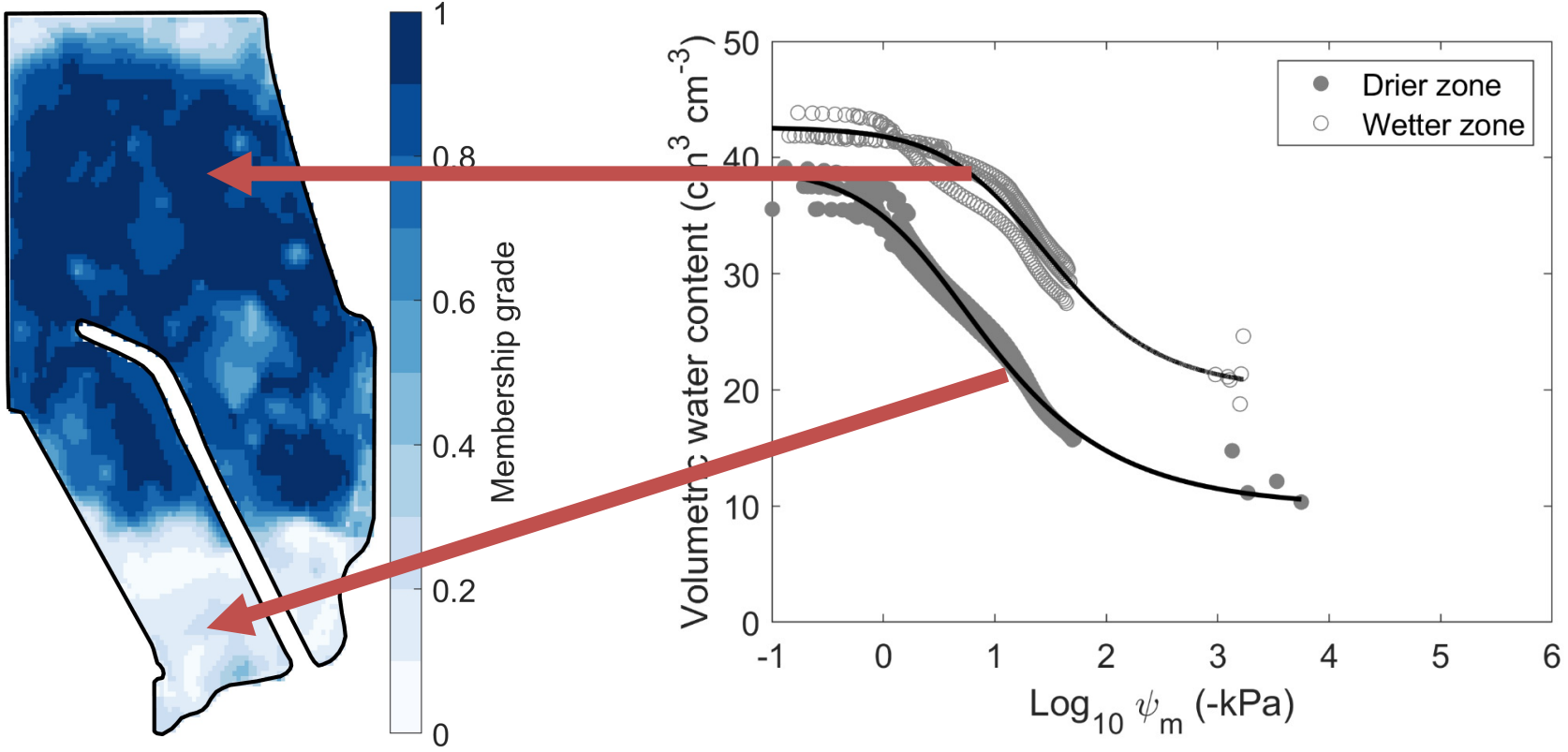
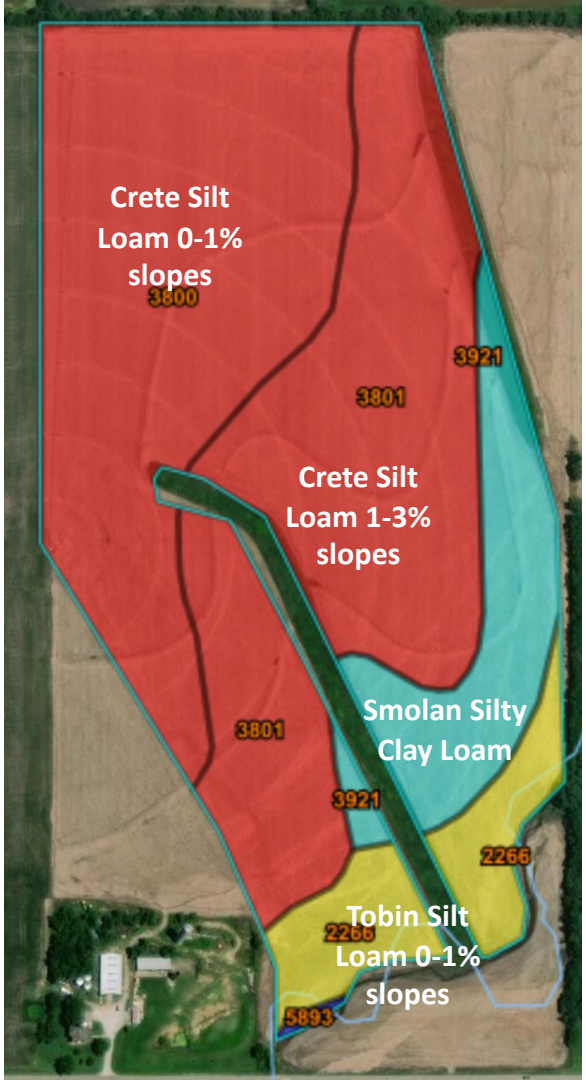
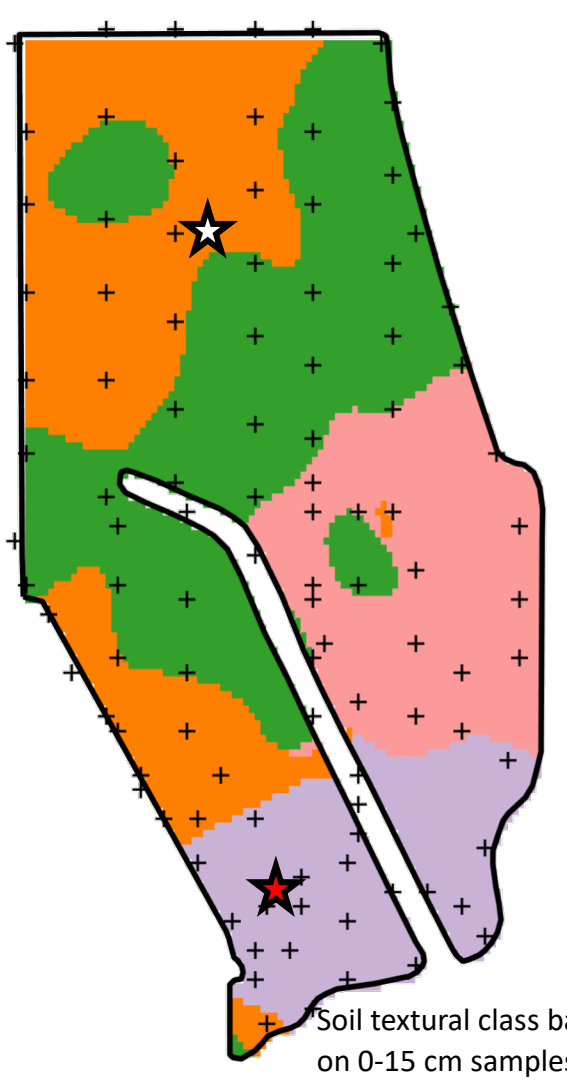
Distinct Soil Moisture-based Management Zones

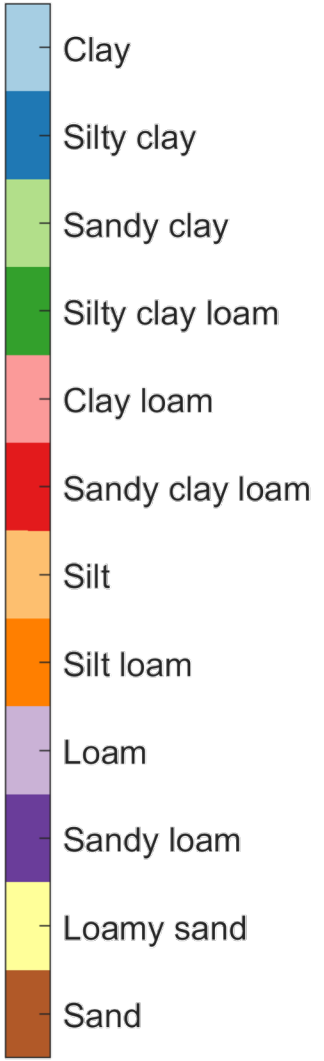




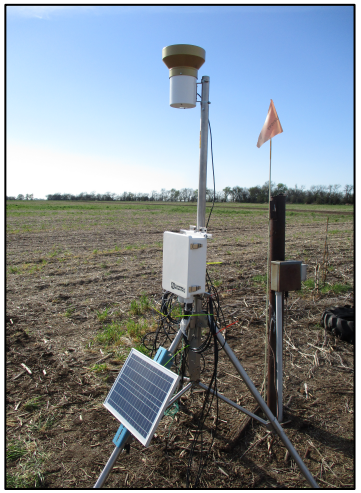
Soil Series from Web Soil Survey



Soil textural class based on 0-15 cm samples



Profile of Research-grade Soil Moisture Sensors



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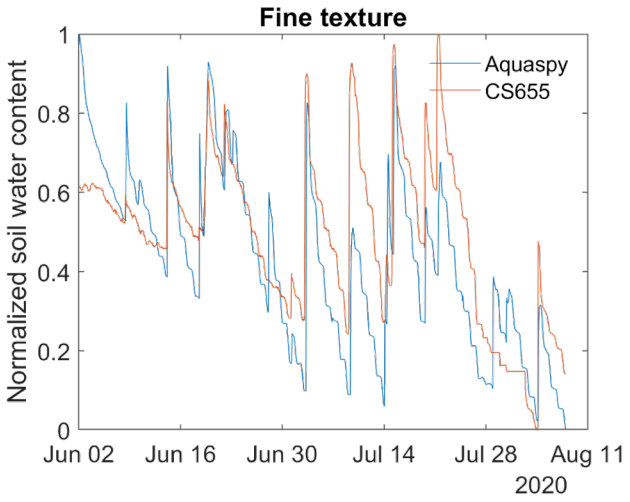

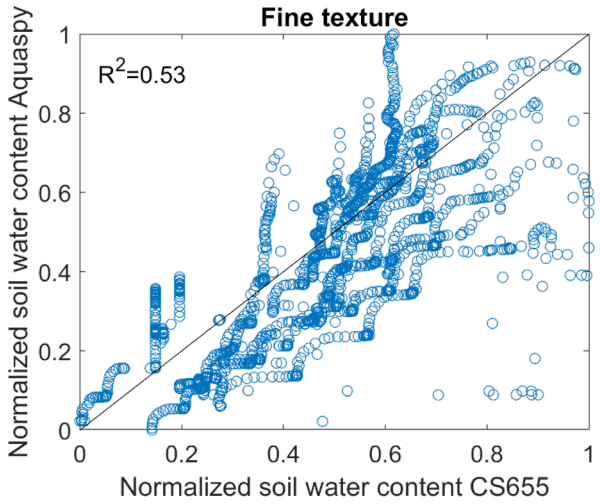

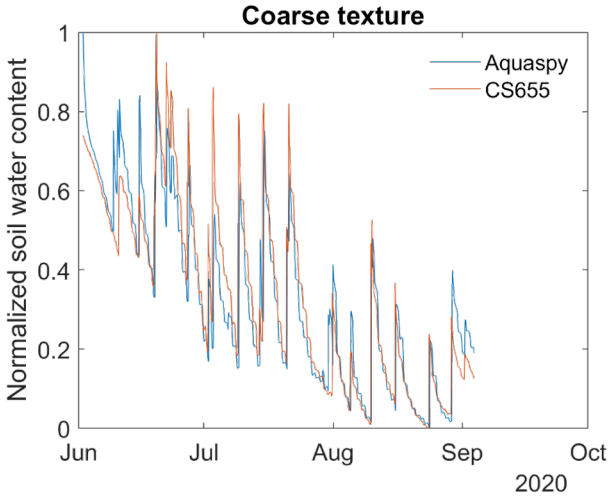

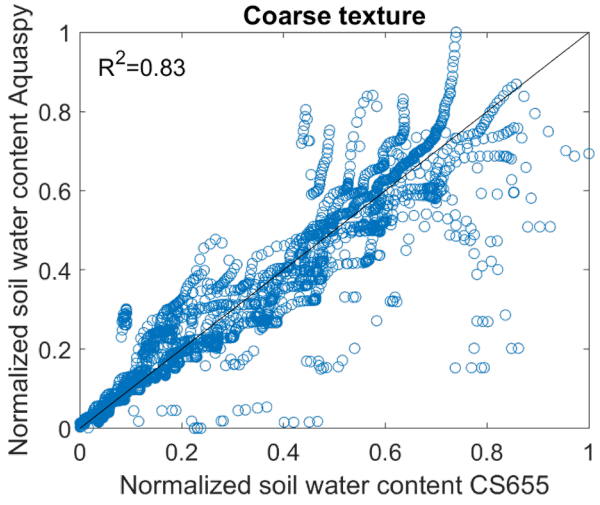

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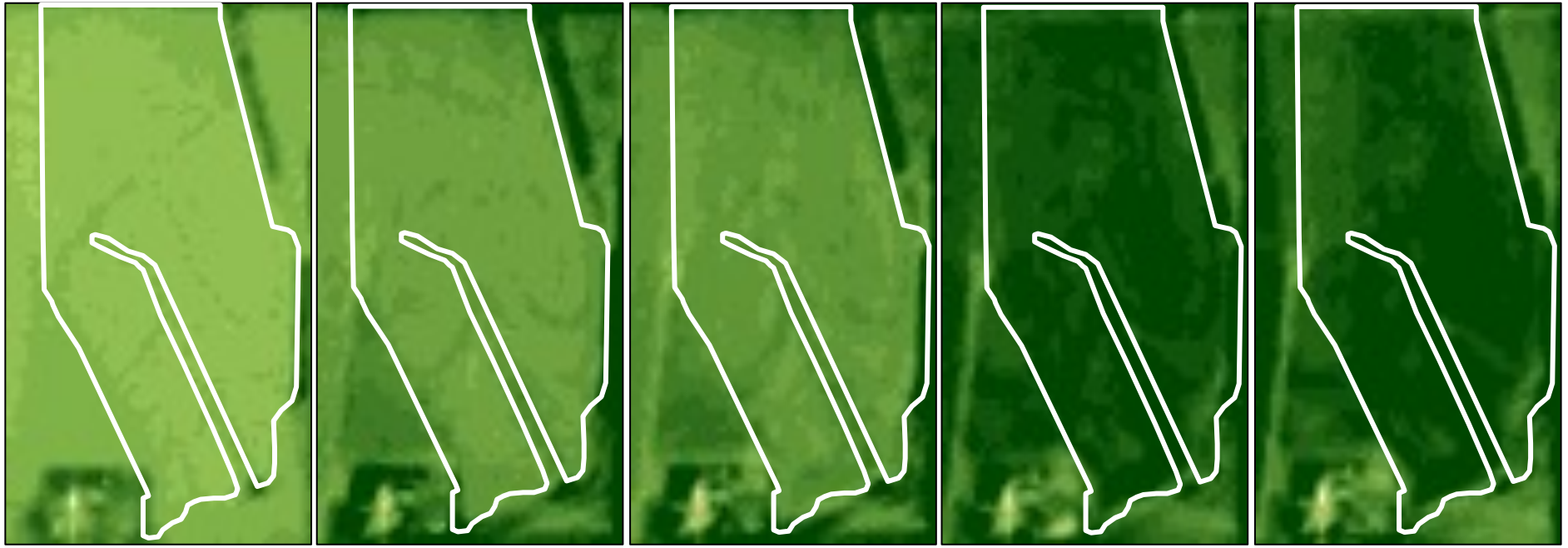
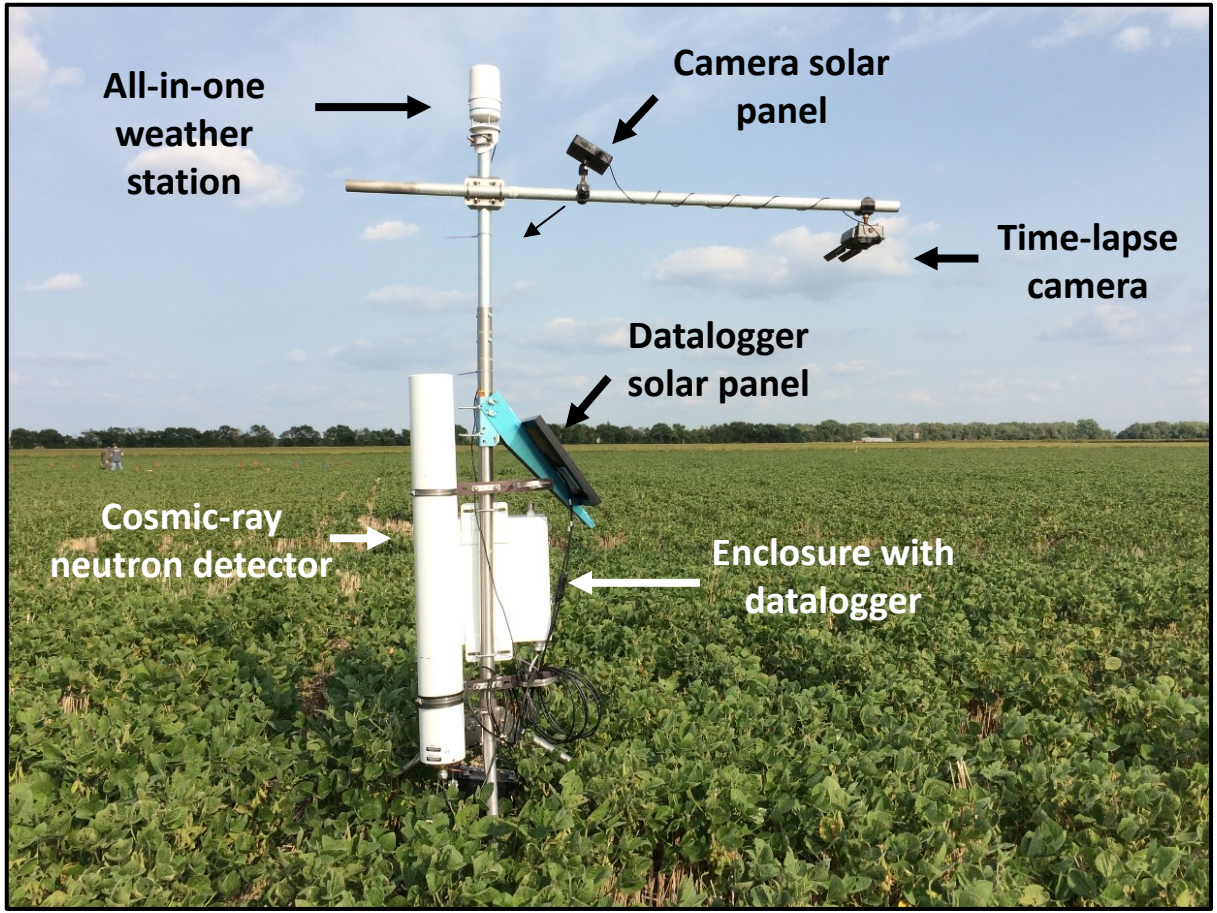
Using NDVI from Sentinel 2



19-April-2020 | 29-May-2020 | 3-June-2020 | 11-June-2020 | 13-June-2020

Remote sensing NDVI does not seem to follow the soil moisture spatial variability of the field. The effect is likely masked by in-season irrigation.

CRopland Observation Nodes (CRONOS)



- New Project funded by the USDA-NIFA Sustainable Agricultural Systems program.
- Emphasis on the Soil-Plant-Atmosphere continuum.
- Flickner Innovation Farm is one the five monitoring stations currently in the program (pilot stage).

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Flickner Innovation Farm Soybean Field on 21-Aug-2020

12 PM Green canopy cover: 70%

3 PM Green canopy cover: 38%

Soil Water Processes Lab

Andres Patrignani (**andrespatrignani@ksu.edu**)
Department of Agronomy – Kansas State University (Manhattan Campus)

ETcrop – Estimate crop water use from digital images**:** https://soilwater.github.io/etcrop
Foliage – Webapp for analysis of green canopy cover: https://soilwater.github.io/foliage
Quadrat – A digital version of the traditional quadrat: https://soilwater.github.io/quadrat
ForecastDualKc – An interactive crop forecasting model: https://soilwater.github.io/fdk

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USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture
NRCS
Natural Resources Conservation Service
KCARE
Kansas Center for Agricultural Resources and the Environment

Rattlesnake Creek Irrigation Innovation Project

Goals

01

Increase adoption of more efficient irrigation packages, soil moisture sensors, and irrigation scheduling tools.

02

Monitor improvements in irrigation efficiency and yield per unit water.

03

Facilitate a peer-to-peer mentoring network to discuss successful strategies.

What is available?

- 50% Cost-share funds for irrigation system upgrades (see flyer for complete list)
- Free technical assistance
- KanSCHED irrigation scheduling assistance and workshops
- Field days

Requirements: Must be located in the Rattlesnake Creek watershed and producer must be EQIP-eligible.

Program Options

	Level 1				Level 2					
	Base Technology				Base Technology (Level 1) + Irrigation System Improvement (select 1 below)					
Description	-Center pivot with real-time monitoring -Continuous rainfall monitoring -Aerial imagery -KanSched -Sensor				Mobile drip irrigation- full conversion		Mobile drip irrigation- hybrid	System package improvement		
	Sensor Options	Soil moisture sensor	Plant based sensors	Autonomous pivot system	Circular planting	Straight row planting	MDI on first 2 spans only	Bubble with shroud	Moving pad	Fixed pad
Estimated Cost	$5,000-$12,000				$25,000-$30,000		$13,000	$17,400	$8,600	$7,400
50% cost share available for all levels and options subject to availability*										
Brand/ Model/ Type Examples**	Agsense FieldNet Watchdog Ceres	AquaSpy Trellis	Phytech	APS	Dragon-Line Precision Mobile Drip Irrigation			Senniger Nelson Komet		
# Available	10	35			3	3	5	2	10	2

*A maximum of 3 technology systems (Levels 1 & 2) per entity or agricultural producer will be funded through this project.
**Suggested suppliers sell equipment useful for irrigation. Brand names are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned.

ANALOGY

Sandwich		Hamburger			Topping Available for Additional Cost					
Cheese					Cheddar	Monterey Jack	Provolone	Pepper Jack	Brie	American
Bun		White	Wheat	Pretzel						

Reduce irrigation costs • Save money • Increase water use efficiency

Requirements

Located in Rattlesnake Creek watershed

EQIP eligible

Continuous signups, but first priority sign-up deadline is April 30, 2021

Data on applied water, crop type and yields

For more information, contact local project partners

The Nature Conservancy
Heidi Mehl
785.424.4164
heidi.mehl@tnc.org

Orrin Feril
620.234.5352
oferil@gmd5.org

WATER PACK
Pat Janssen
620.546.4463
patmilanjanssen@gmail.com

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

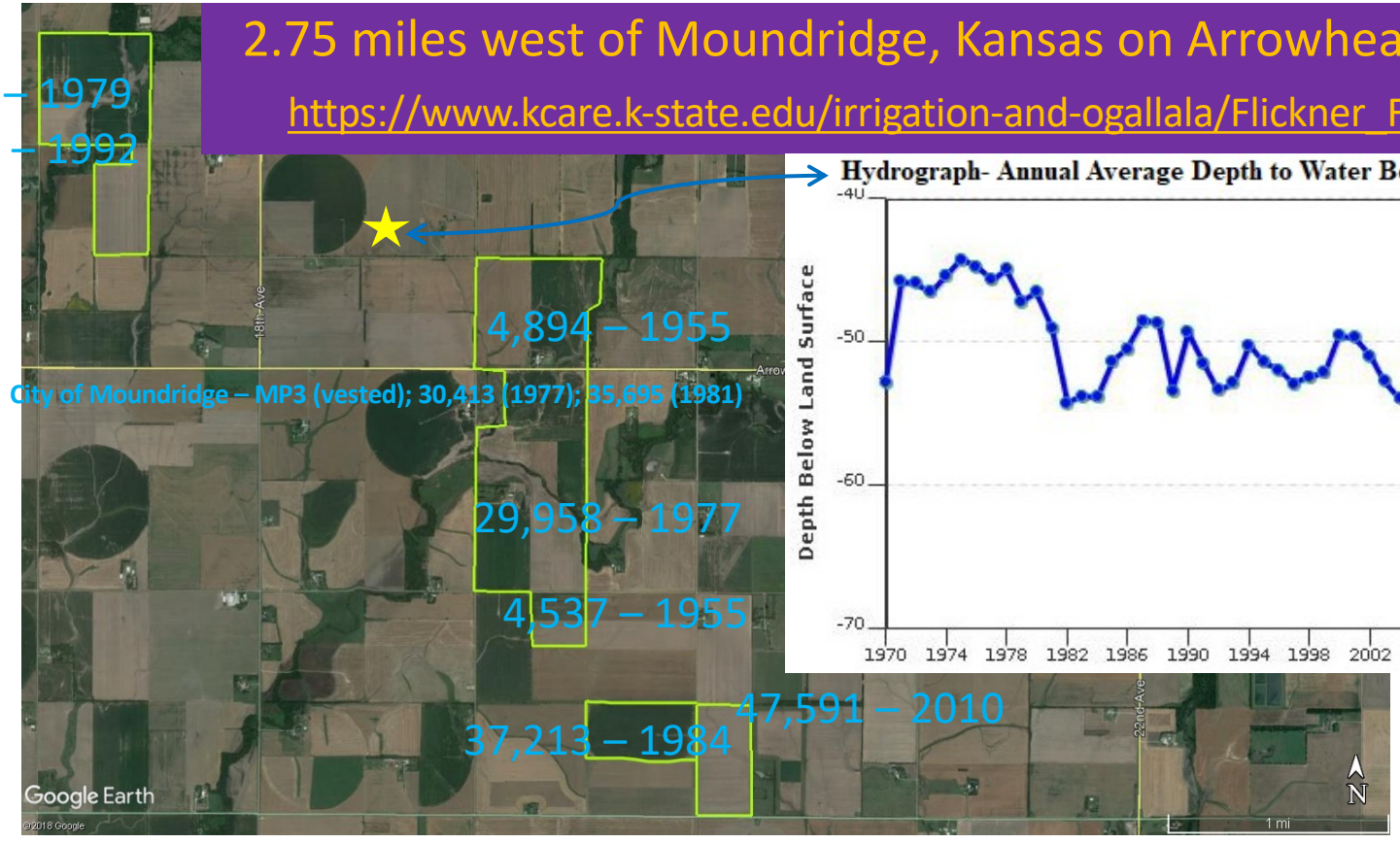
K-STATE Research and Extension
Jeff Davidson
620.583.4437
jdavidso@ksu.edu

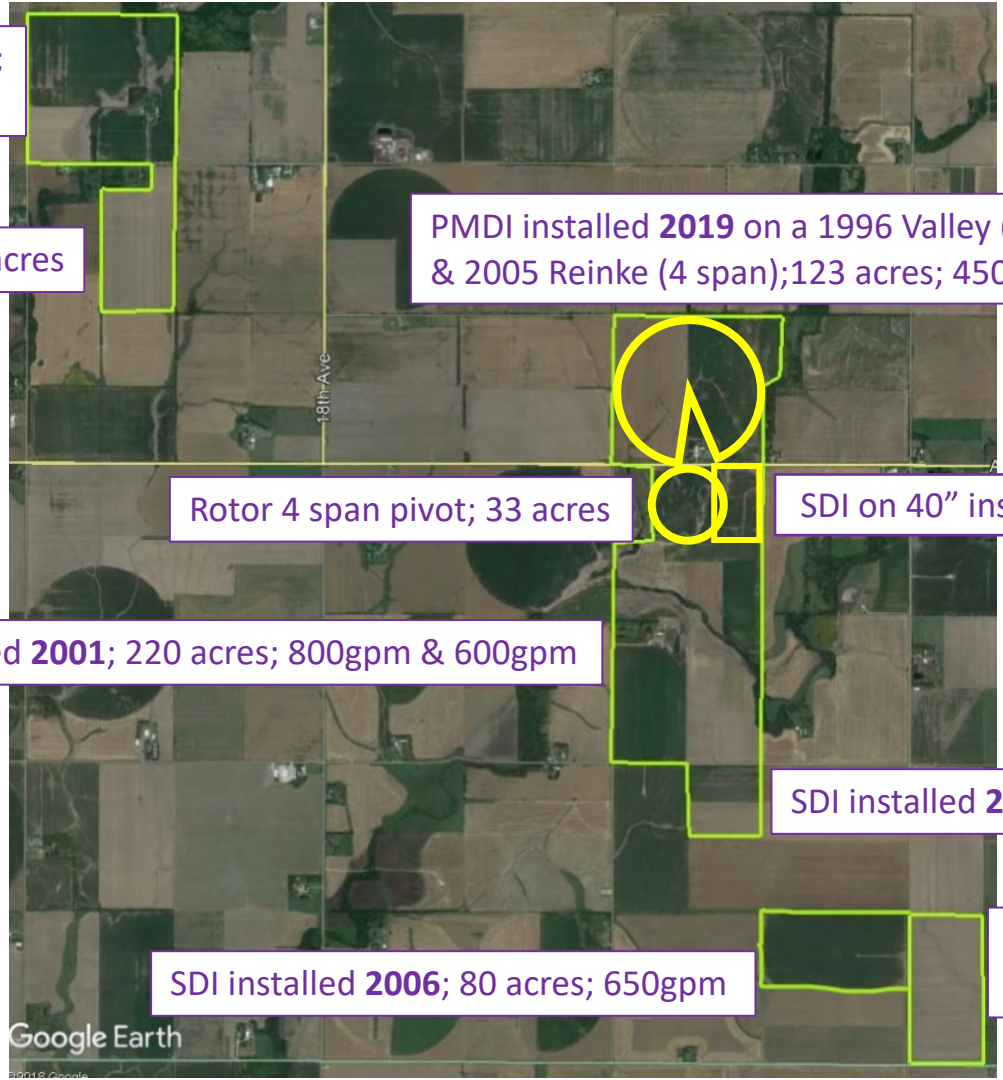
NRCS and K-State Extension offices in **Edwards, Ford, Kiowa, Pawnee, Pratt, Reno, Rice, Stafford** counties

Flickner Innovation Farm

2.75 miles west of Moundridge, Kansas on Arrowhead Avenue

https://www.kcare.k-state.edu/irrigation-and-ogallala/Flickner_Farm.html





SDI installed **2004**; 154 acres; 500gpm & 200gpm

SDI installed **2005**; 71 acres

PMDI installed **2019** on a 1996 Valley (3 span) & 2005 Reinke (4 span);123 acres; 450gpm

Rotor 4 span pivot; 33 acres

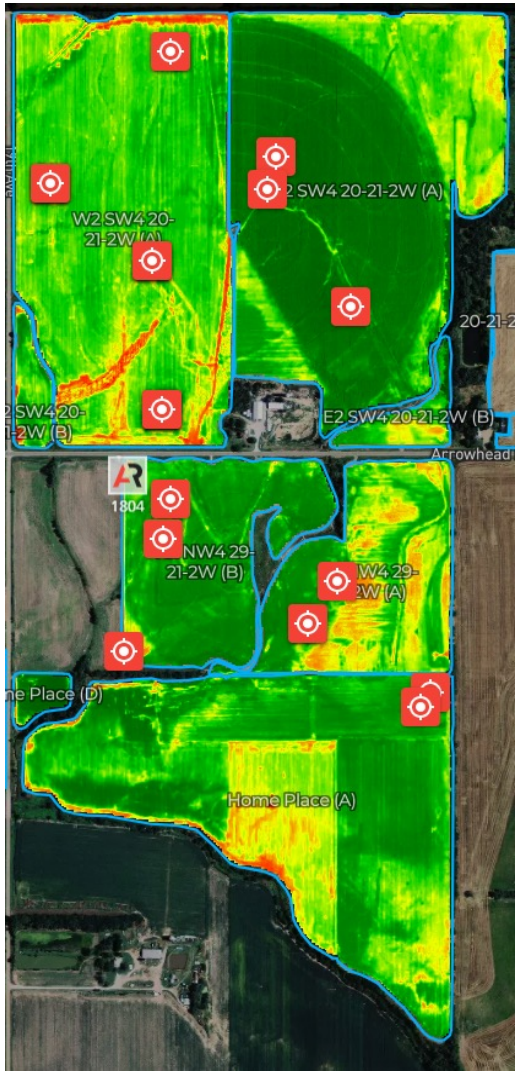
SDI on 40" installed **2020**; 23 acres

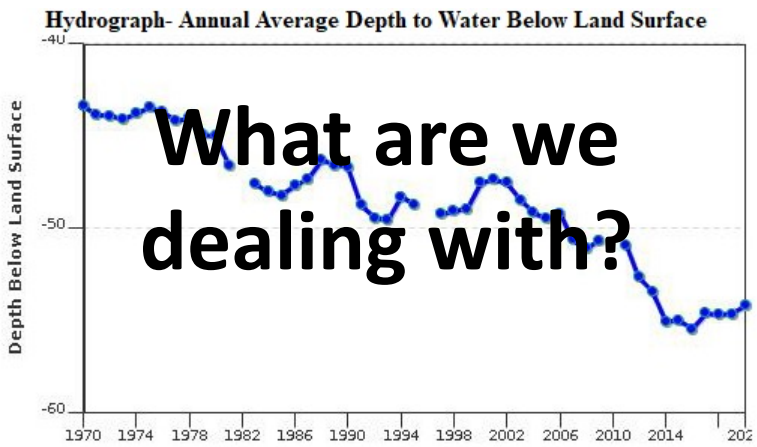
SDI installed **2001**; 220 acres; 800gpm & 600gpm

SDI installed **2010**; 40 acres

SDI installed **2006**; 80 acres; 650gpm

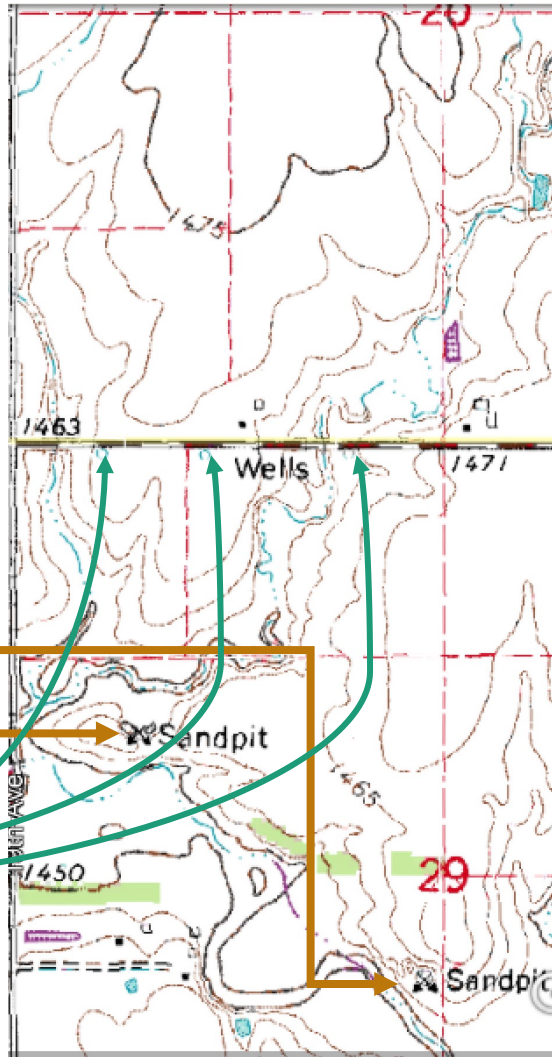
SDI on 40" installed **2015**; 78 acres; 650gpm





What are we dealing with?

- Topography (>25’ change)
- Sand pits
- Creek & slough
- 3 muni wells (quality concerns)
- Declining aquifer



Sample Name	EC	pH	NH4-N	No3-n	Na	date Analyzed	Water Right#	Date collected	WR#
Home South	0.5	7.19	<0.01	7.52	21.49	6/18/2020	4537	6/15/2020	4537
Home South	0.44	7.15	<0.01	6.88	21.17	7/24/2020	4537	7/21/2020	
Dave	0.6	7.3	<0.01	7	28.41	6/18/2020	4894	6/15/2020	4894
Dave	0.67	7.27	0.02	8.65	33.51	9/19/2020	4894	9/16/2020	
Home Yard White bottle	0.56	7.9	<0.01	18	27.72	6/18/2020	29958	5/20/2020	29958
Home Yard Nalgene	0.52	7.48	0.54	9.2	22.58	6/18/2020	29958	6/15/2020	
Home Yard	0.5	7.37	0.33	7.89	24.82	7/24/2020	29958	7/21/2020	
Home Yard	0.56	7.06	0.01	9.01	26.23	9/19/2020	29958	9/16/2020	
Jonas Yard	0.7	7.11	<0.01	8.42	23.45	6/18/2020	32552	6/15/2020	32552
Jonas Yard	0.67	7.25	0.02	7.94	26.2	8/13/2020	32552	7/30/2020	
Jonas Yard	0.74	7.18	0.03	9.03	27.97	9/19/2020	32552	9/16/2020	
Kirby	0.85	7.2	<0.01	3.68	40.79	6/18/2020	37027	6/15/2020	37027
Kirby	0.78	7.28	0.01	4.3	45.76	8/13/2020	37027	8/6/2020	
Kirby	0.88	7.25	0.02	4.21	47.77	9/19/2020	37027	9/16/2020	
Gringo	1440	7.46		28.4		2/22/2006	37213		
Gringo	1400	7.3		19.3		7/12/2019	37213	7/11/2019	37213
Gringo	1.28	7.25	0.39	20.58	92.51	7/24/2020	37213	7/18/2020	
Gringo	0.71	7.22	0.01	7.57	34.34	9/19/2020	37213	9/16/2020	
Jonas West	0.66	7.17	0.06	3.92	23.65	7/1/2020	40699	6/29/2020	40699
Jonas West	0.61	7.38	0.01	3.96	26.17	7/24/2020	40699	7/21/2020	
Jonas West	0.68	7.24	0.02	4.02	25.68	9/19/2020	40699	9/16/2020	
Lone Elm	524	7.28		1.6		12/12/2014	47591	12/8/2014	47591
Lone Elm	0.46	7.18	0.01	2.31	21.17	7/1/2020	47591	7/1/2020	
Lone Elm	0.55	7.35	0.01	3.08	20.89	8/13/2020	47591	7/30/2020	
House	0.51	7.23	<0.01	4.42	18.66	7/1/2020		7/1/2020	Domestic

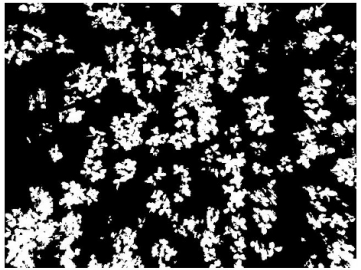
City Well nitrate

Date	Well # 8	Well # 9	Well # 12	POE	Lab	Well # 10	Well # 13	POE	
5/23/2016				1.6	KDHE			6	KDHE
8/30/2016	13.9				SDK				
8/30/2016				1.8	SDK				
8/30/2016		7.84			SDK				
8/30/2016			1.91		SDK				
8/29/2016					SDK	5.68			SDK
8/29/2016					SDK		3.1		SDK
8/29/2016					SDK			6.48	SDK
5/22/2017	14.00				SDK				
5/22/2017				10.2	SDK				
5/22/2017		5.77			SDK				
5/22/2017			2.07		SDK				
5/22/2017					SDK	5.86			SDK
5/22/2017					SDK		2.54		SDK
5/22/2017					KDHE			2.2	KDHE
5/22/2017				9.1	KDHE				
5/22/2017					SDK			2.62	SDK
5/7/2018	12.6				SDK				
5/7/2018		19.2			SDK				
5/7/2018			2.32		SDK				
5/7/2018				9.65	SDK				
5/7/2018					SDK	7.07			SDK
5/7/2018					SDK		2.71		SDK
5/7/2018					SDK			NA	NA
5/16/2018					KDHE			2.2	KDHE
5/16/2018				6.3	KDHE				
5/21/2019				6.3	KDHE				
5/21/2019					KDHE			6.7	KDHE

CRopland Observation NOdeS

Select node

Flickner



Timestamp: 2020-07-23 09:00:00

Green canopy cover (%): 25.8

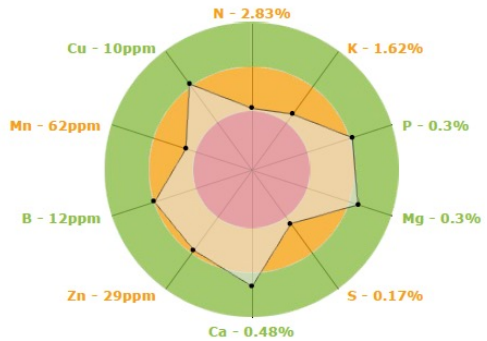
Tissue Sampling = 7/14/2020 @ R2

MKC Shared growth. Shared success.

Ray Flickner
2701 N North Shore Cir,
Wichita, KS,
67205-1079

Farm Name: **Flickner**
Field Name: **Big Pivot**
Sample Name: **FFT**
Submitter Name: **Blake Berner**
Report Date: **07/16/2020**
Sample Date: **07/14/2020**

Nitrogen 2.83% / N-Responsive	Manganese 62ppm / Mn-Responsive
Phosphorus 0.3% / P-Adequate	Copper 10ppm / Cu-Adequate
Potassium 1.62% / K-Responsive	
Sulfur 0.17% / S-Responsive	
Boron 12ppm / B-Adequate	
Zinc 29ppm / Zn-Responsive	
Magnesium 0.3% / Mg-Adequate	
Calcium 0.48% / Ca-Adequate	



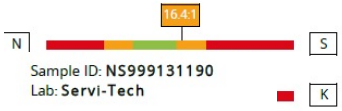
Crop: **CORN**
Stage: **R2**

GPS Latitude: **38.206301**
GPS Longitude: **-97.570659**

Sample ID: **NS999131190**
Lab: **Servi-Tech**

MID-KANSAS COOP ASSN-MOUN
307 W COLE ST, PO BOX D,
null,
Kansas,
67107-7533

MKC Shared growth. Shared success.



Ray Flickner
2701 N North Shore Cir,
Wichita, KS,
67205-1079

Farm Name: **Goering 80**
Field Name: **Goering 80**
Sample Name: **Sample 1 Goering 80**
Submitter Name: **Blake Berner**
Report Date: **07/16/2020**
Sample Date: **07/14/2020**

ganese
m / Mn-Deficient

er
m / Cu-Adequate

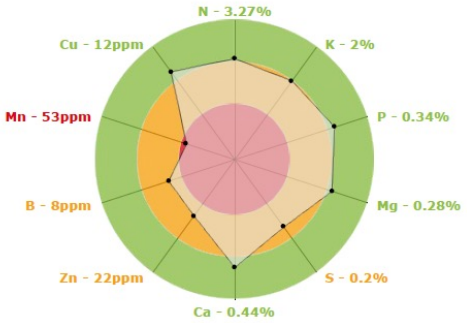
Crop: **CORN**
Stage: **R2**

GPS Latitude: **38.180525**
GPS Longitude: **-97.554328**

Sample ID: **NS999131191**
Lab: **Servi-Tech**

MID-KANSAS COOP ASSN-MOUND
307 W COLE ST, PO BOX D,
null,
Kansas,
67107-7533

SDI







Types of Irrigation

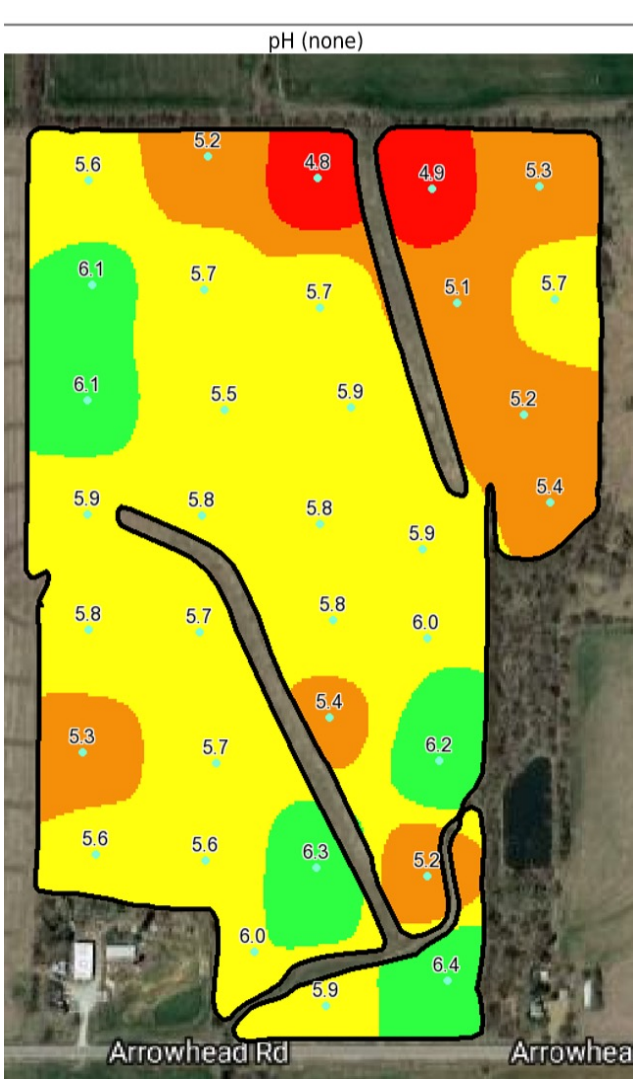
-Poly-pipe flood
-PMDI
-Rotor pivot
-Natural flood
-SDI on 60” and 40”

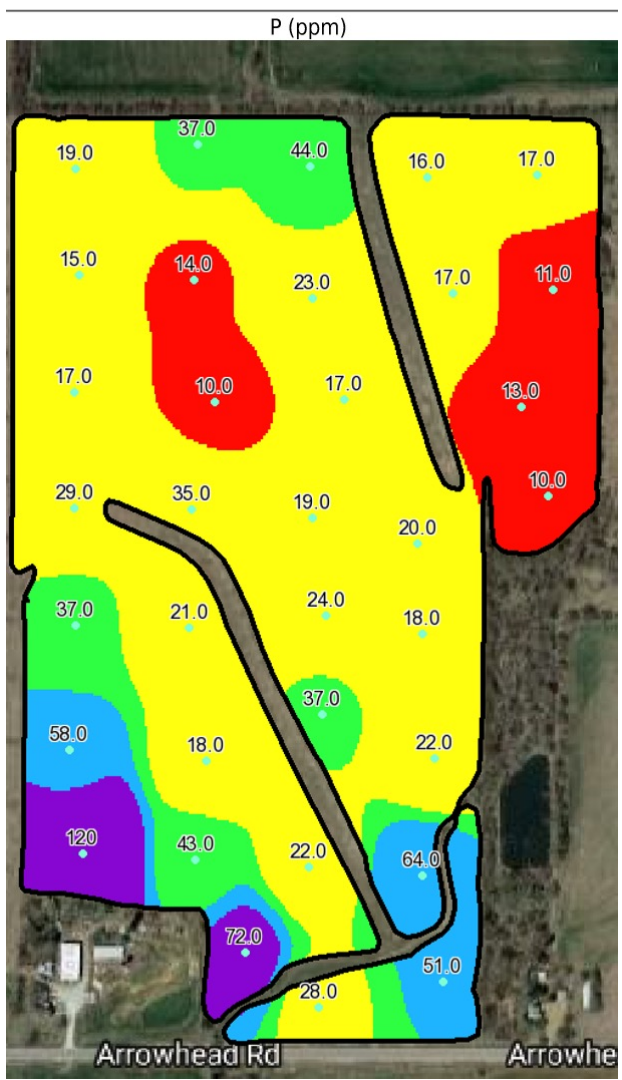
Precision Mobile drip Irrigation (PMDI)

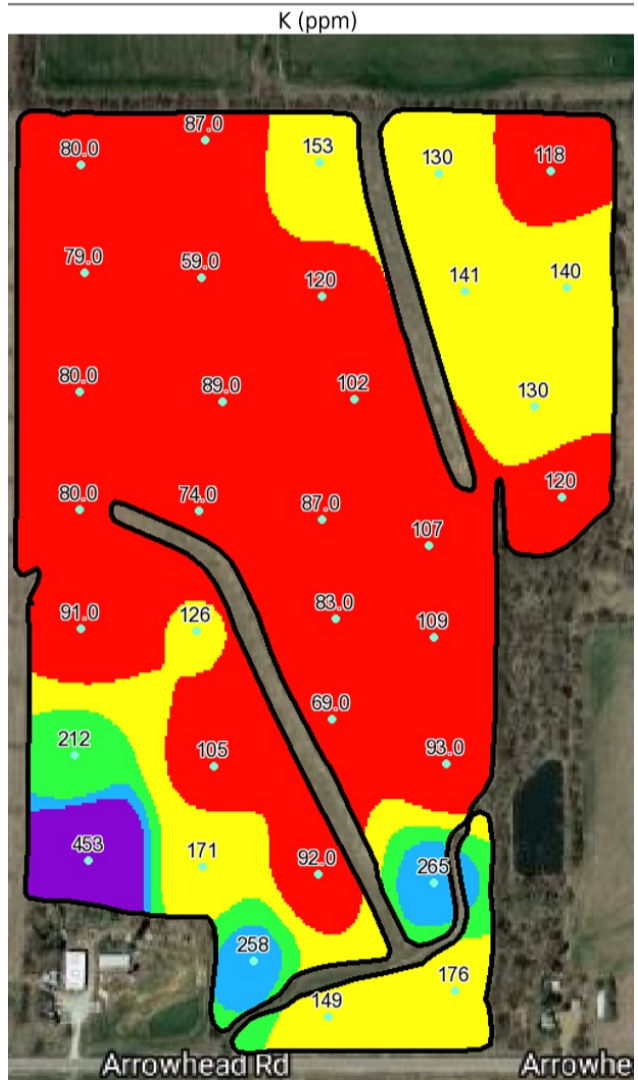
6 spans on 20”, 1 span on 30”

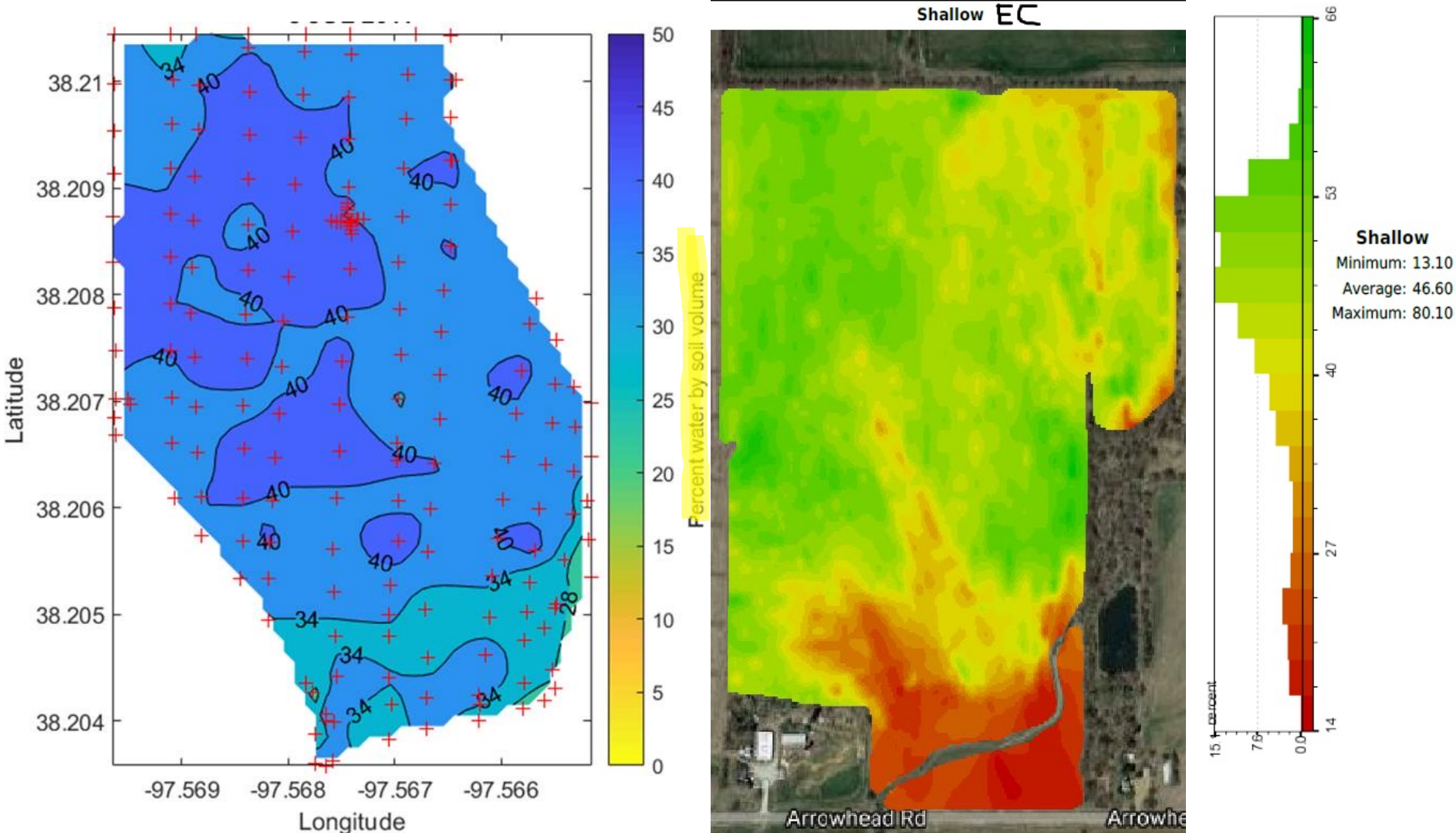
Windshield whipper pivot irrigations ~123 acres

PMDI in action


pH (none)
5.6
5.2
4.8
4.9
5.3
6.1
5.7
5.7
5.1
5.7
6.1
5.5
5.9
5.2
5.4
5.9
5.8
5.8
5.9
5.8
5.7
5.8
6.0
5.4
5.3
5.7
6.2
5.6
5.6
6.3
5.2
6.0
6.4
5.9
Arrowhead Rd
Arrowhea

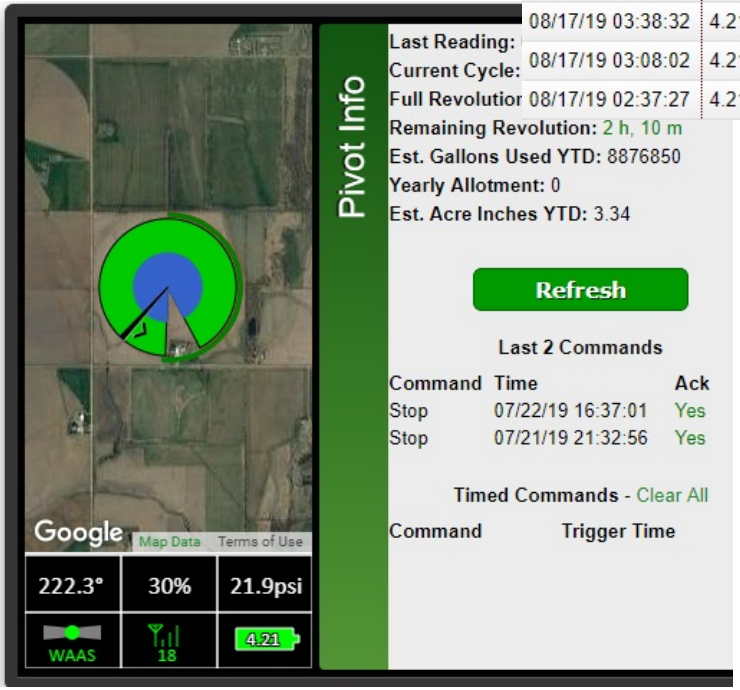

P (ppm)
19.0
37.0
44.0
16.0
17.0
15.0
14.0
23.0
17.0
11.0
17.0
10.0
17.0
13.0
10.0
29.0
35.0
19.0
20.0
37.0
21.0
24.0
18.0
37.0
58.0
18.0
22.0
120
43.0
22.0
64.0
72.0
51.0
28.0
Arrowhead Rd
Arrowhe

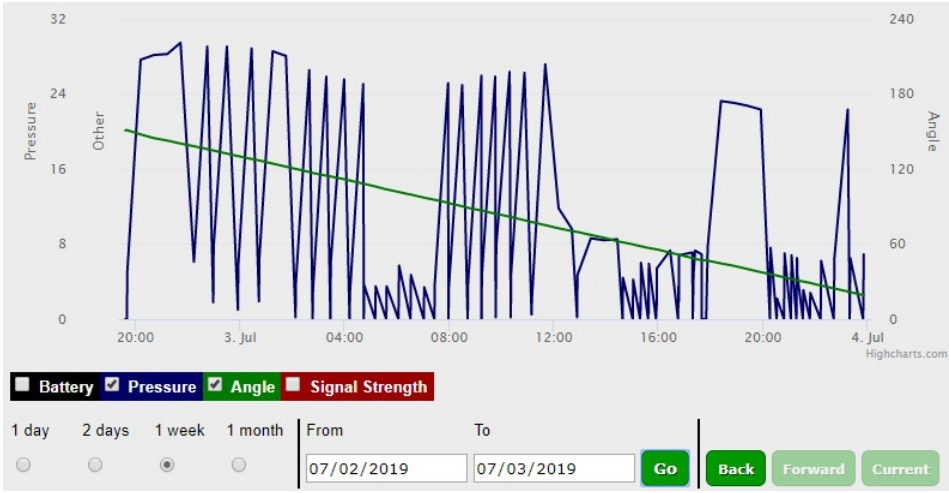

K (ppm)
80.0
87.0
153
130
118
79.0
59.0
120
141
140
80.0
89.0
102
130
80.0
74.0
87.0
107
120
91.0
126
83.0
109
69.0
212
105
93.0
453
171
92.0
265
258
176
149
Arrowhead Rd
Arrowhe


Latitude
38.21
38.209
38.208
38.207
38.206
38.205
38.204
-97.569
-97.568
-97.567
-97.566
Longitude
34
40
28
50
45
40
35
30
25
20
15
10
5
0
Percent water by soil volume
Shallow EC
Arrowhead Rd
Arrowhe
66
53
40
27
14
15
7.6
0.0
percent
Shallow
Minimum: 13.10
Average: 46.60
Maximum: 80.10

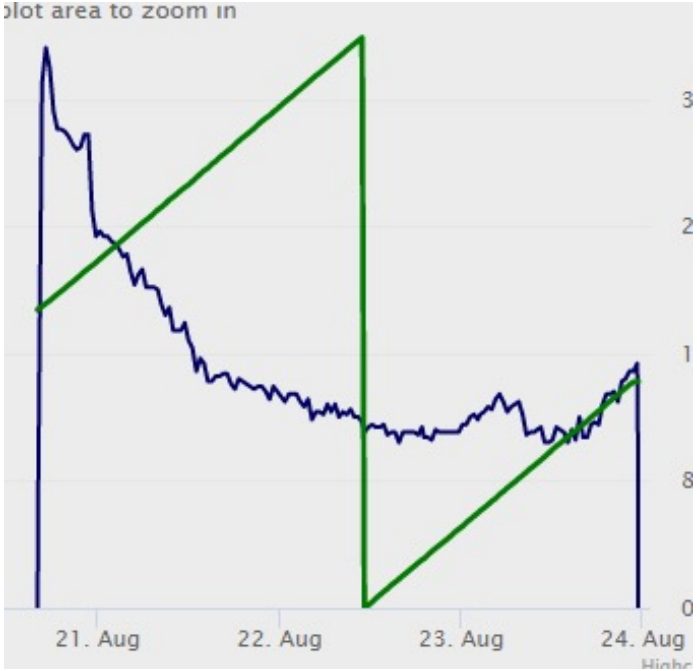
AgSense 2019

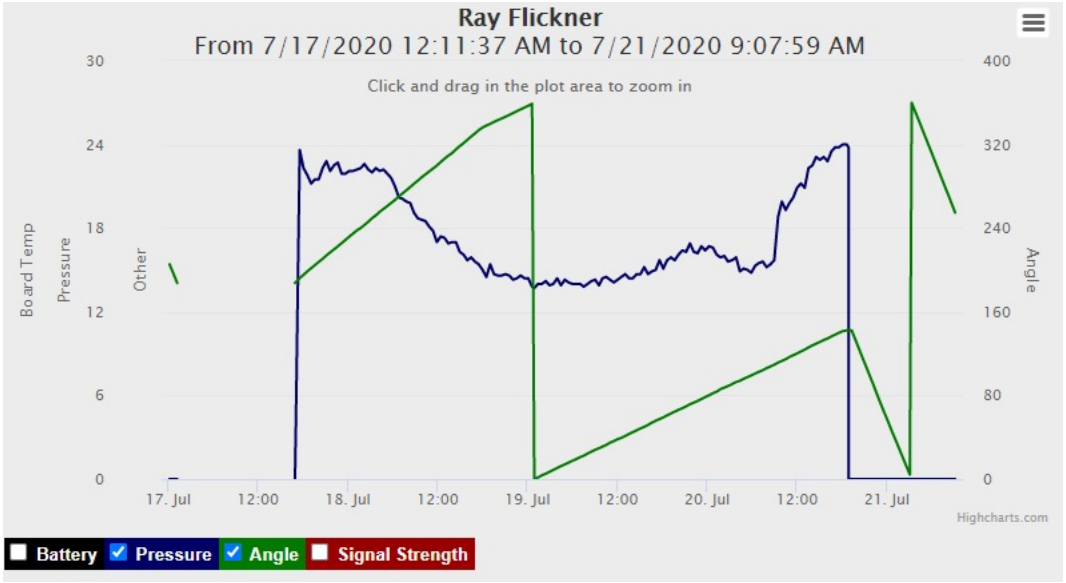
Time	Bat	Pres (psi)	Angle
08/17/19 07:42:50	4.21	21.9	222.3
08/17/19 07:12:15	4.21	21.6	224.7
08/17/19 06:41:44	4.2	21.6	227.8
08/17/19 06:11:08	4.2	21.6	230.5
08/17/19 05:40:35	4.21	21.9	233.5
08/17/19 05:10:13	4.21	22.1	236.2
08/17/19 04:39:37	4.21	22.2	239.1
08/17/19 04:09:11	4.2	22.3	241.9
08/17/19 03:38:32	4.21	22.2	244.9
08/17/19 03:08:02	4.21	22.1	248
08/17/19 02:37:27	4.21	22.1	250.7





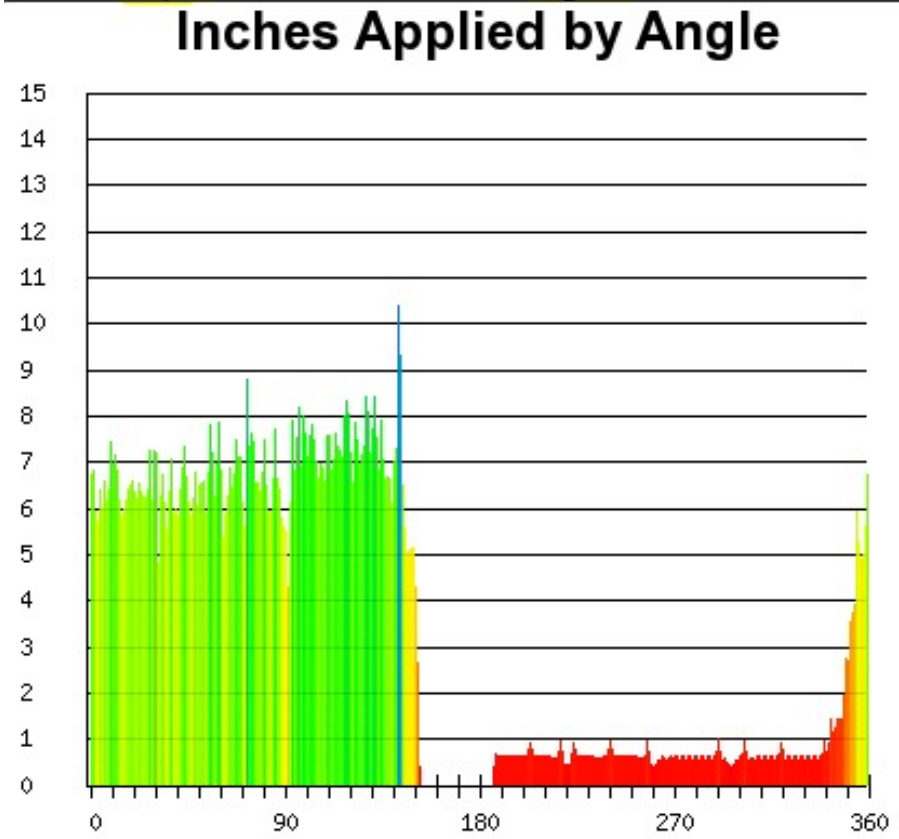
AgSense 2020

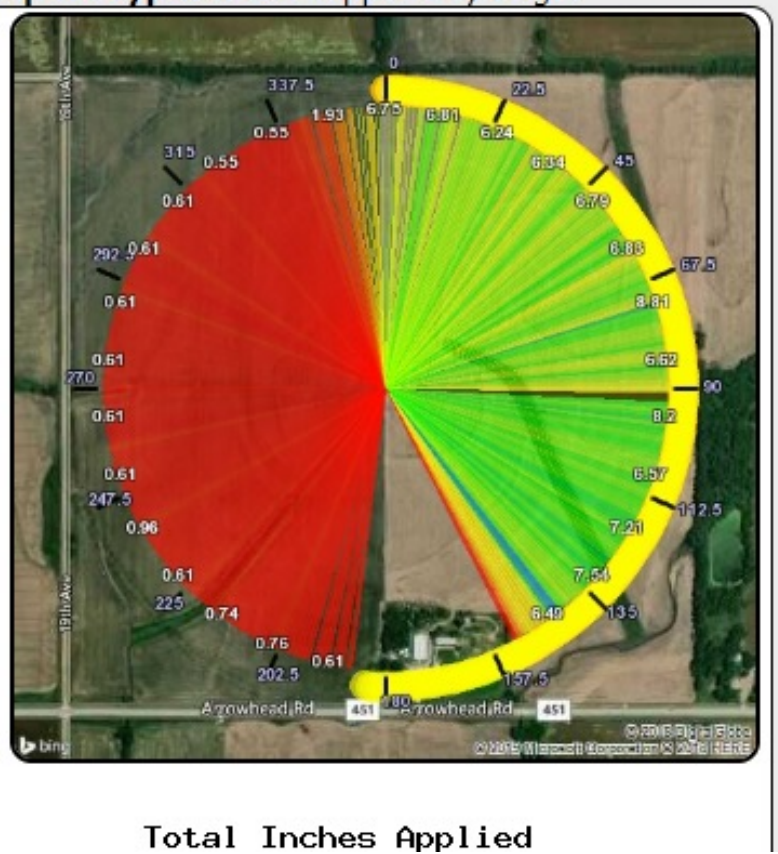




AgSense 2019

May 16, 2019 12:00 AM - Aug 20, 2019 11:59 PM - **Report Type:** Inches Applied by Angle





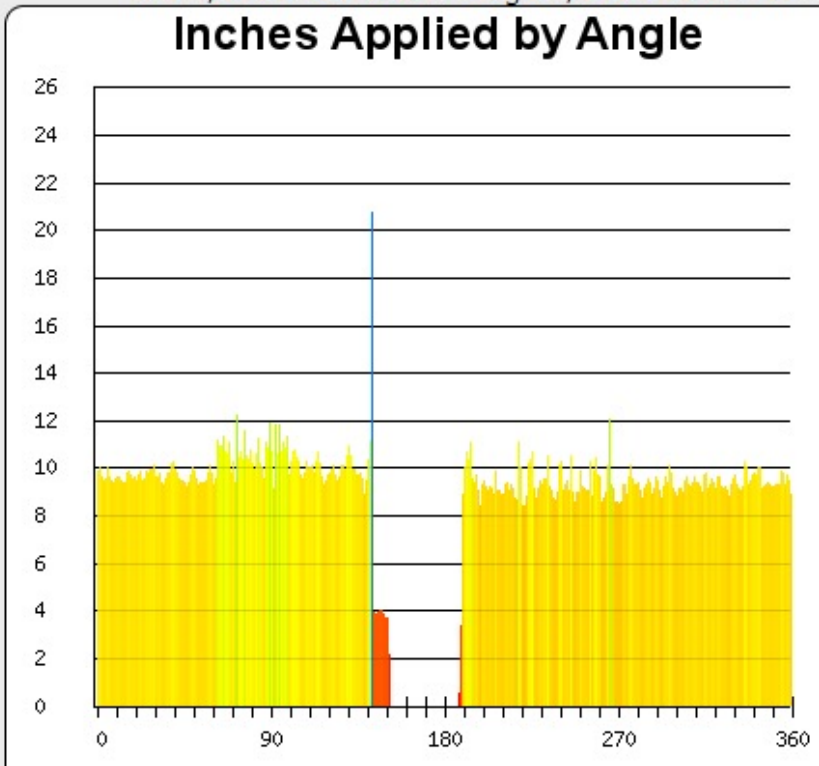
Total Inches Applied

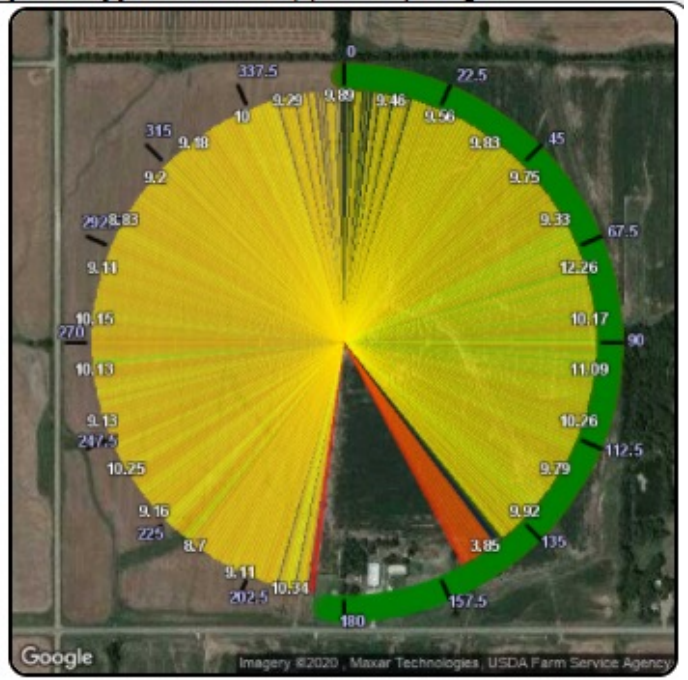
AgSense 2020

Ray Flickner

105677

Jun 4, 2020 12:00 AM - Aug 24, 2020 11:59 PM - **Report Type:** Inches Applied by Angle





Total Inches Applied

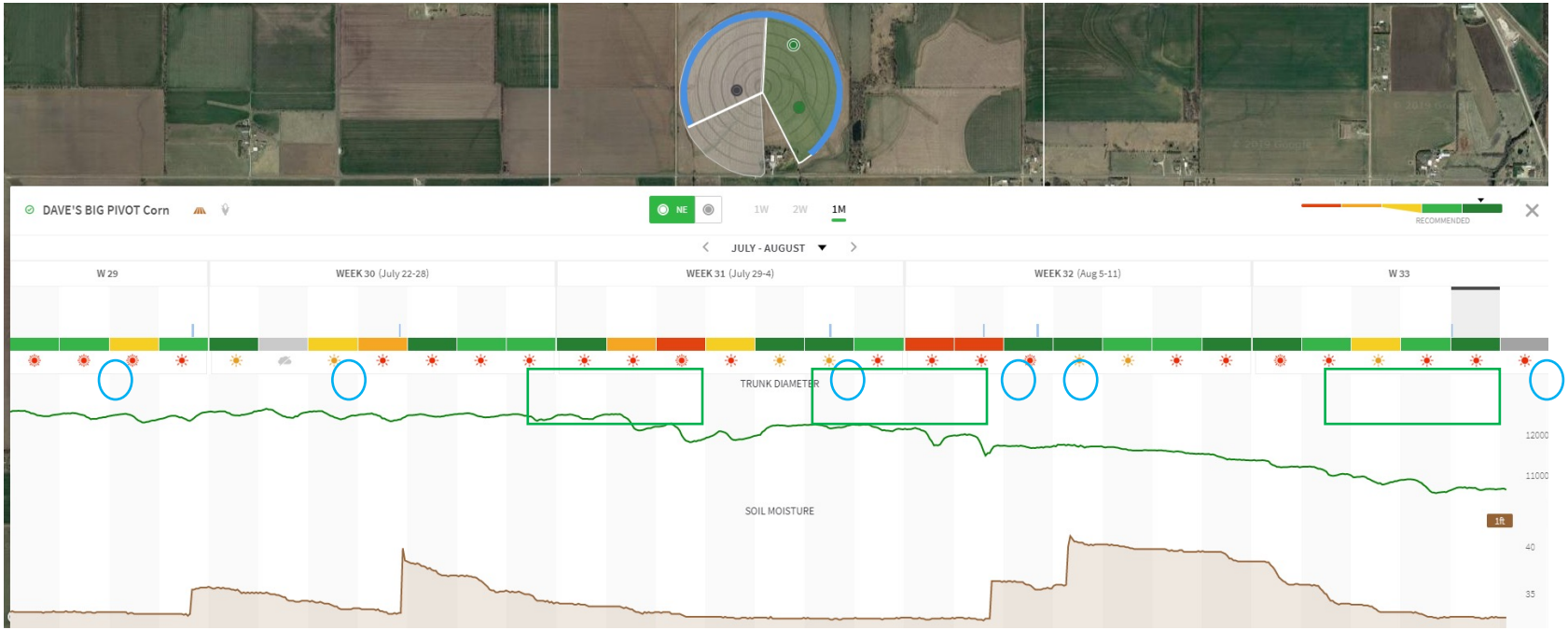
Ways We Monitored Crop Stress

Plant Based

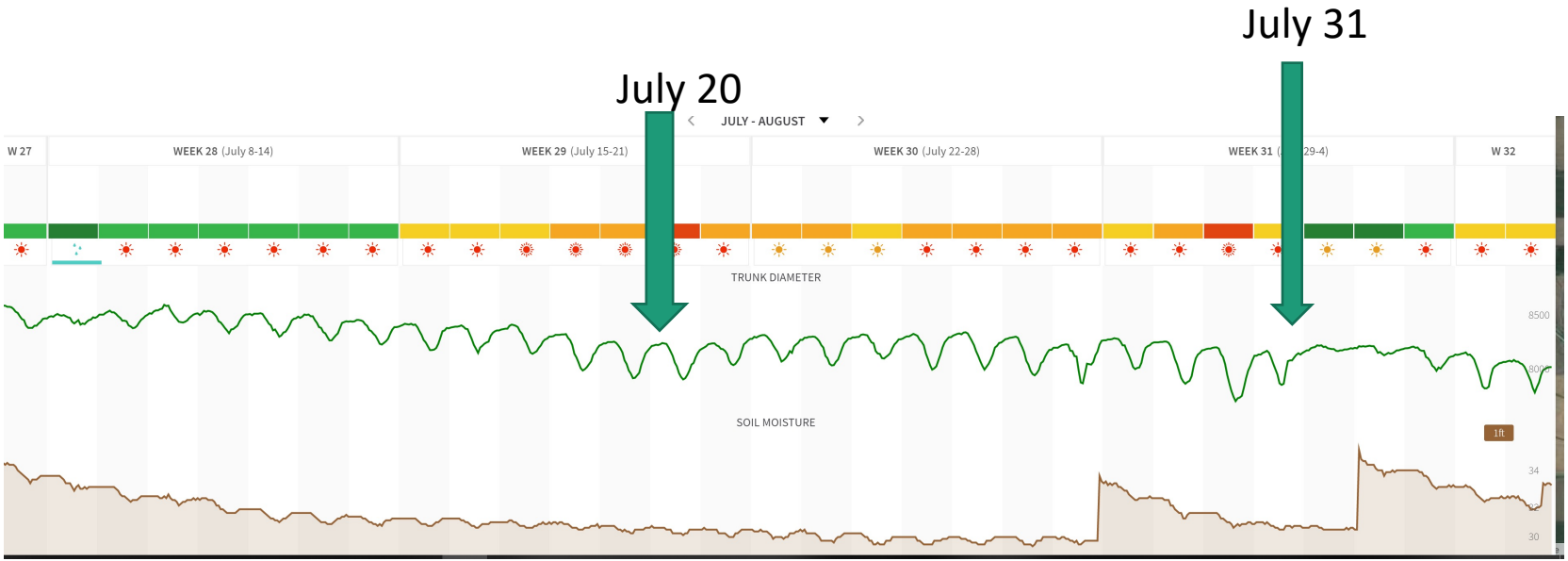
Ground Moisture

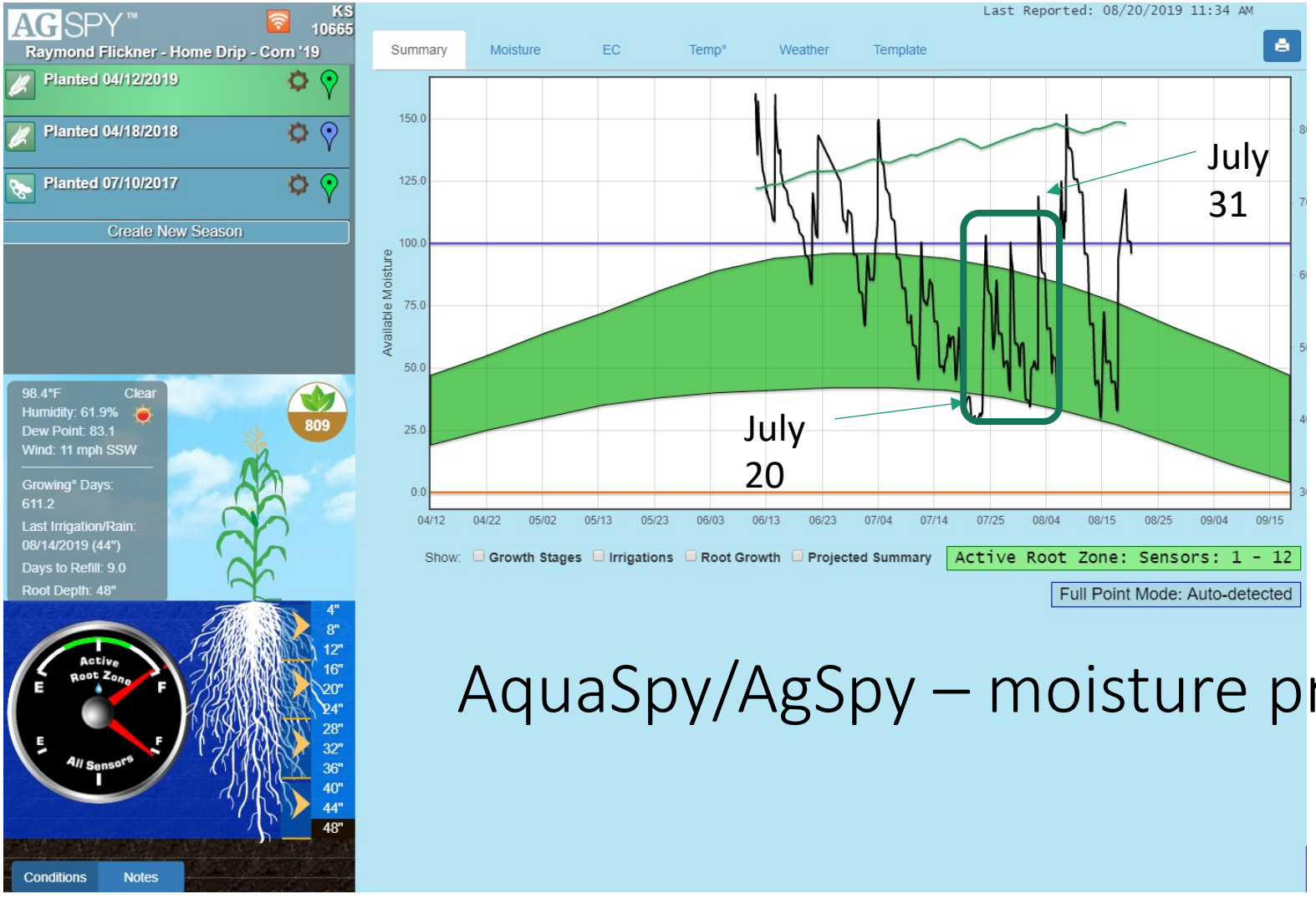
Imagery

Phytech – irrigation events; plant health

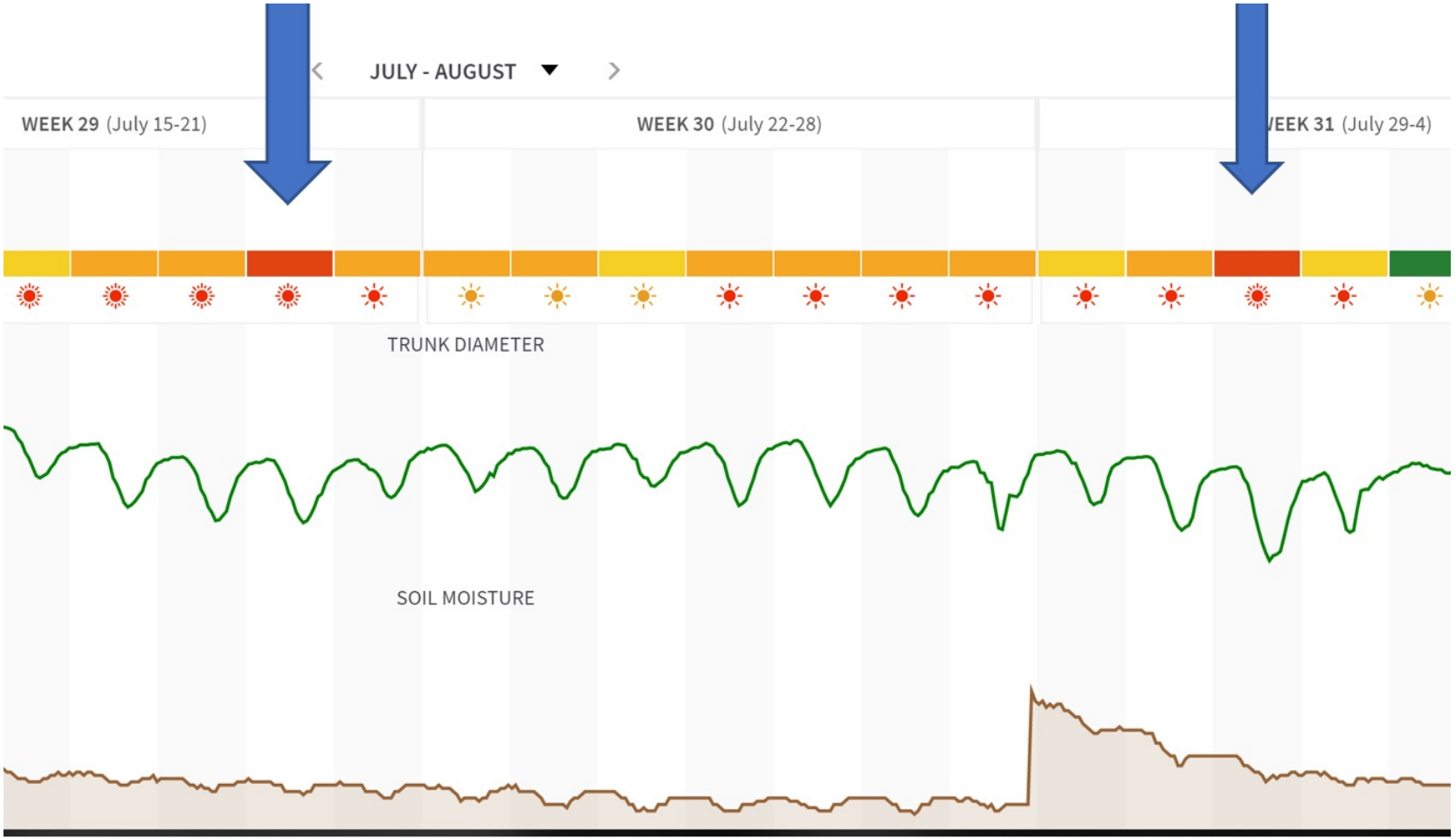


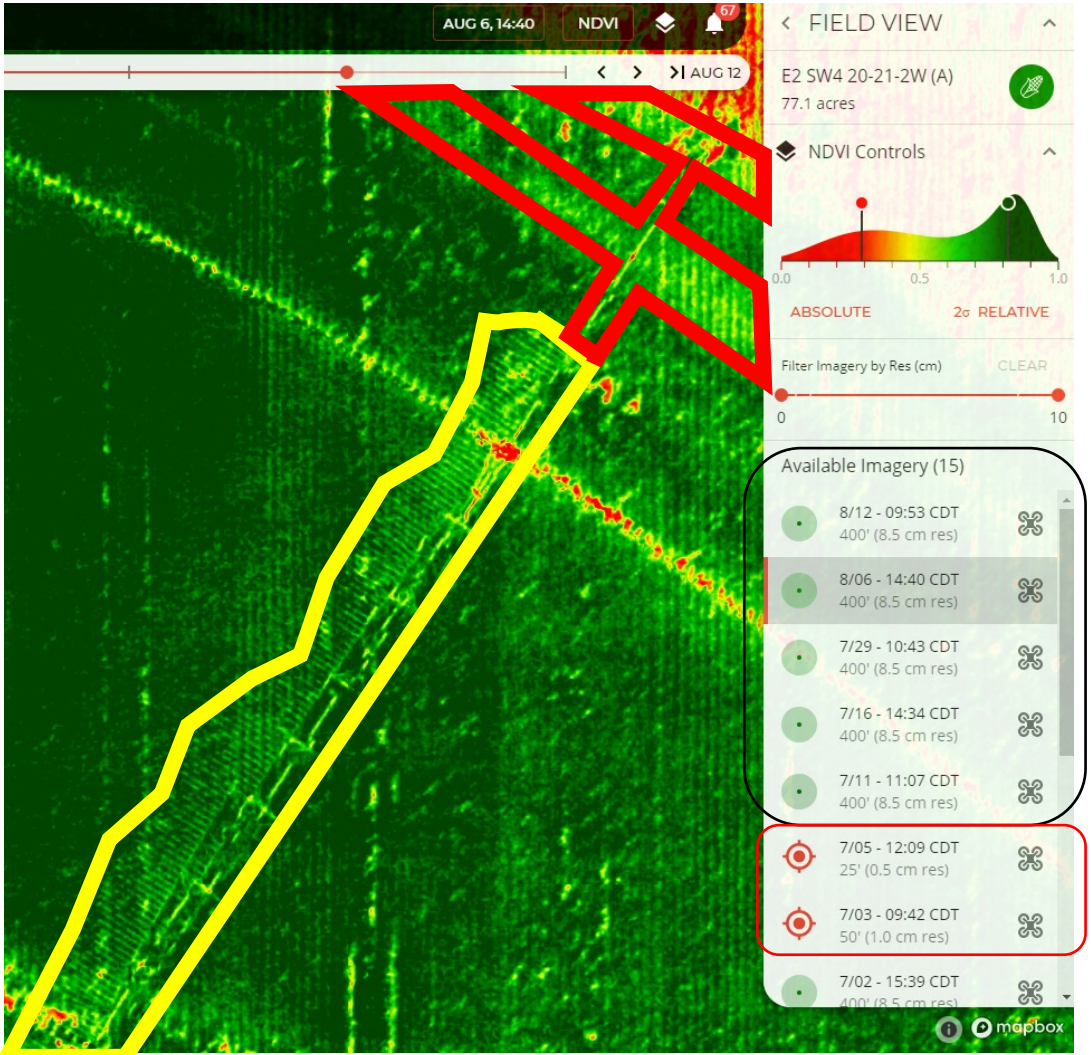
Phytech – Home place SDI





AquaSpy/AgSpy – moisture probe


JULY - AUGUST
WEEK 29 (July 15-21)
WEEK 30 (July 22-28)
TRUNK DIAMETER
SOIL MOISTURE

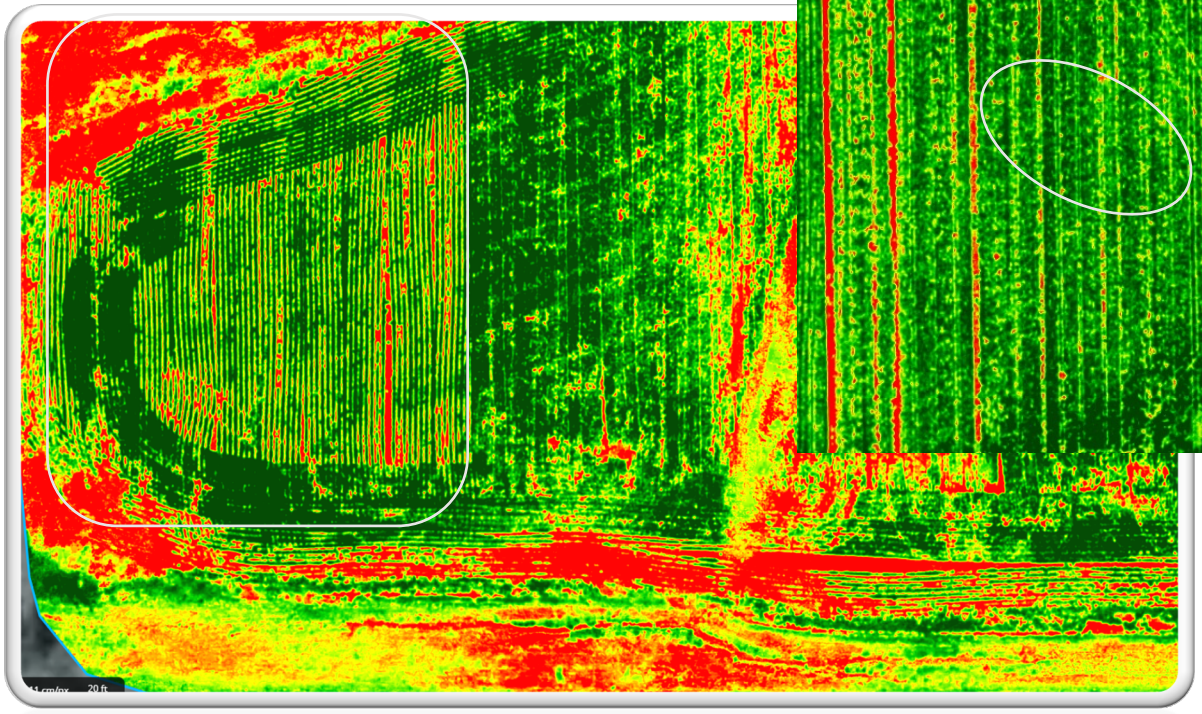


American Robotics

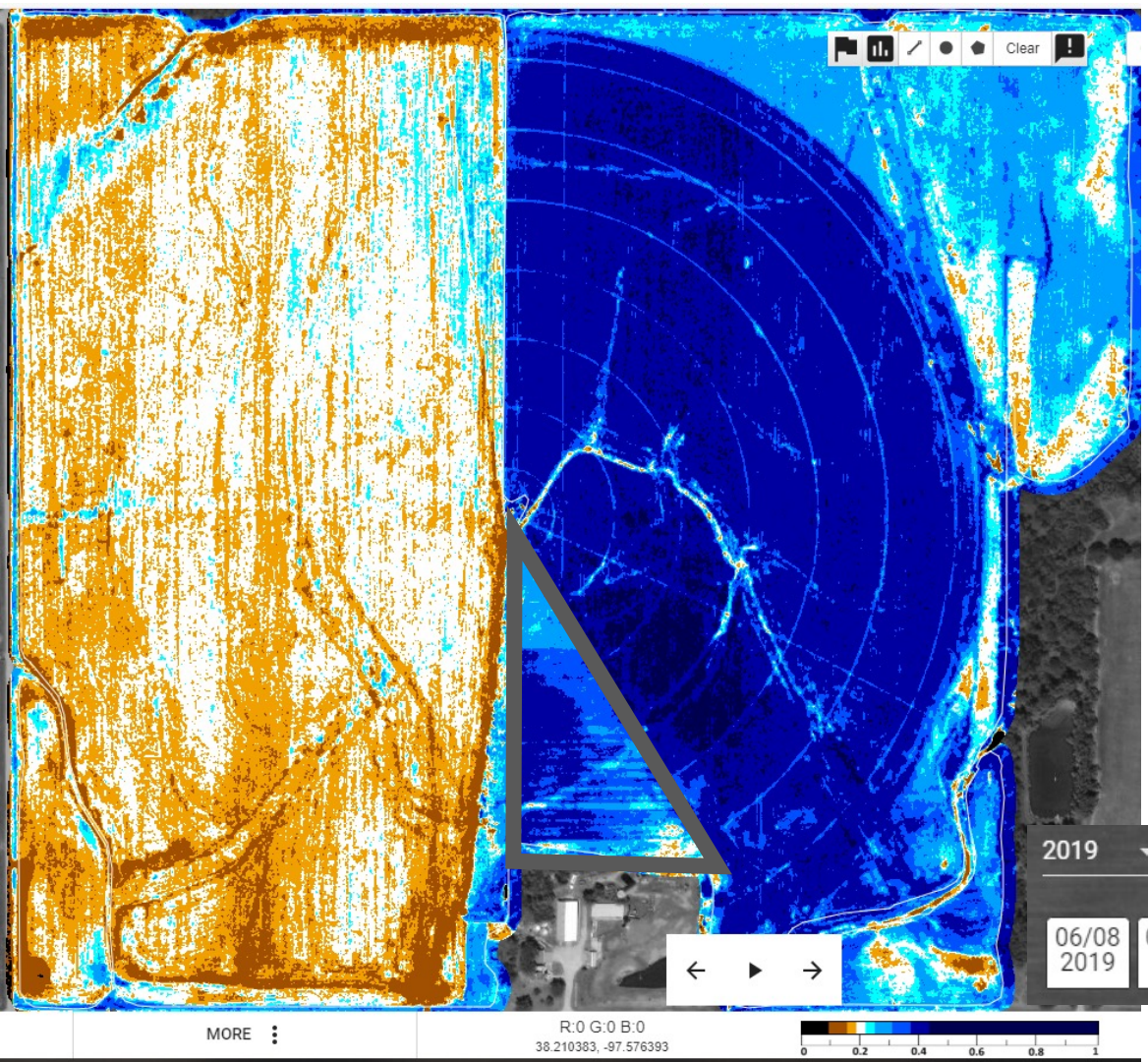
–

“UAS/drone in a box”

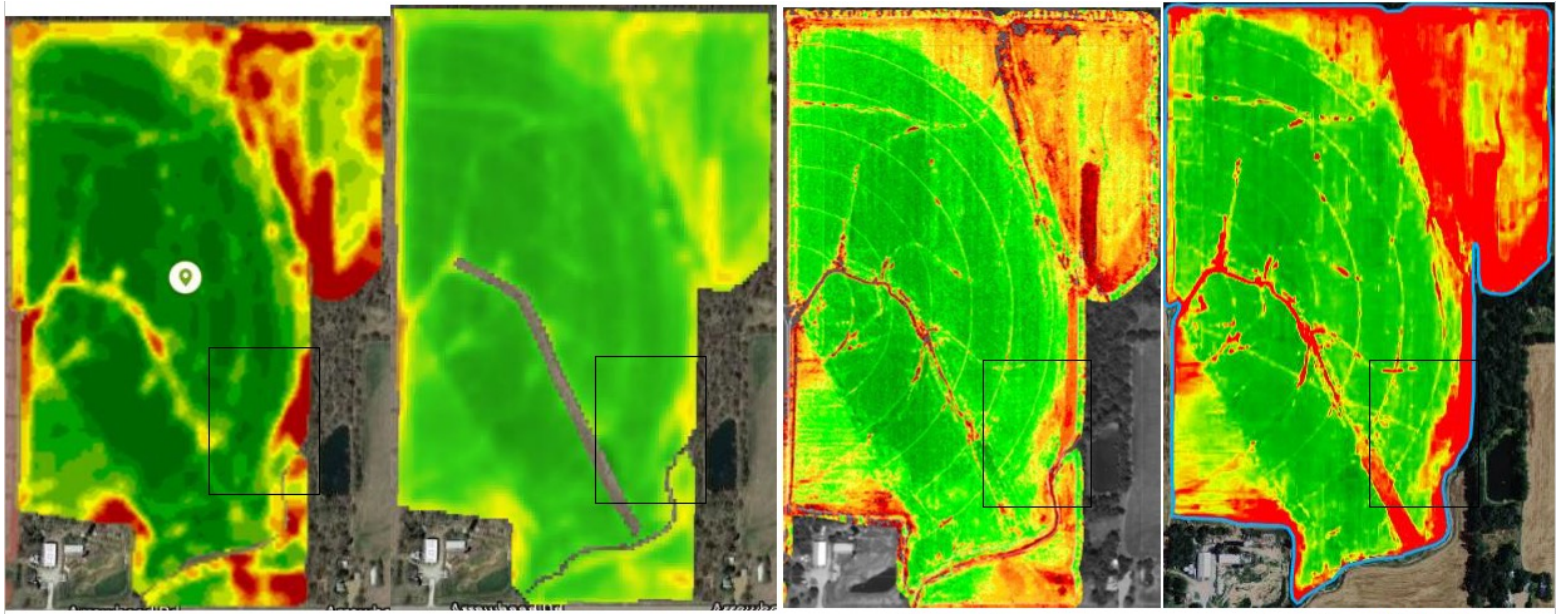
Ability to take stand count…



TerrAvion – fixed wing flyovers



Imagery comparison = R7, ClimateView, Terravion, American Robotics



R7
7/19/2019

Climate
7/19/2019

Terravion
7/18/2019

American Robotics
7/16/2019

Questions and Discussion

KCARE
Kansas Center for Agricultural Resources and the Environment

K-STATE
Research and Extension

Water resource management and irrigation in Kansas

Upcoming session: Thursday, April 8, 8:30am

Topic: Irrigating Lawns and Urban Water Conservation

Presenters: Cathie Lavis, K-State Department of Horticulture and Natural Resources; and Holly Dickman, Water Conservation Specialist, City of Hays

Hosted by: Natural Resources PFT and KCARE

KCARE
Kansas Center for Agricultural Resources and the Environment

K-STATE
Research and Extension