



Programmable Irrigation & Fertigation

Jose Baer, PowWow Energy

OpenFarm

October 23, 2019

Collaborators: PowWow Energy, WHCC, and UCSB

Primary Investigator: Olivier Jerphagnon (PWE)

Project Manager: Kevin Langham(PWE)

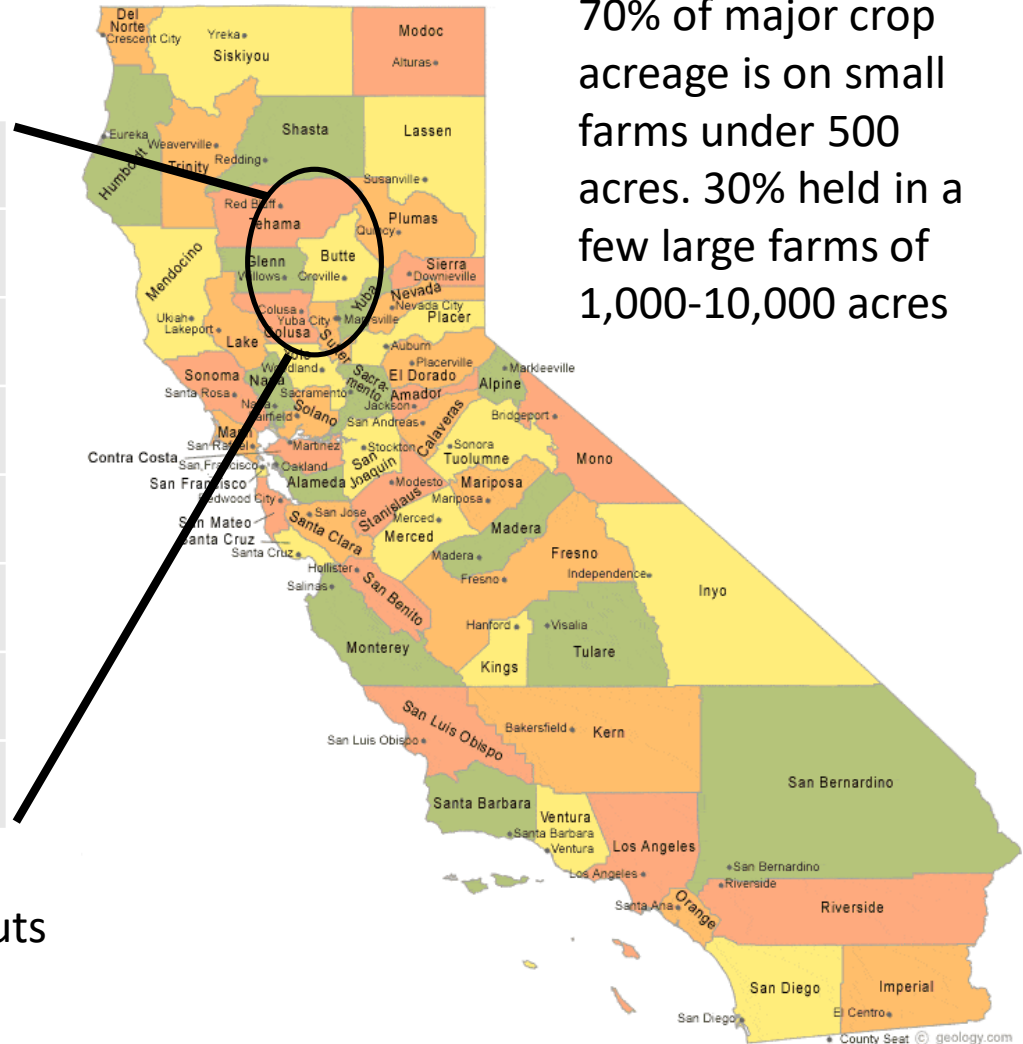
Co-PI for automation: Guillermo Valenzuela (WCE)

Co-PI for DAC: Terry Brase (WHCC)

Co-PI for M&V: Dr. Geyer (UCSB)

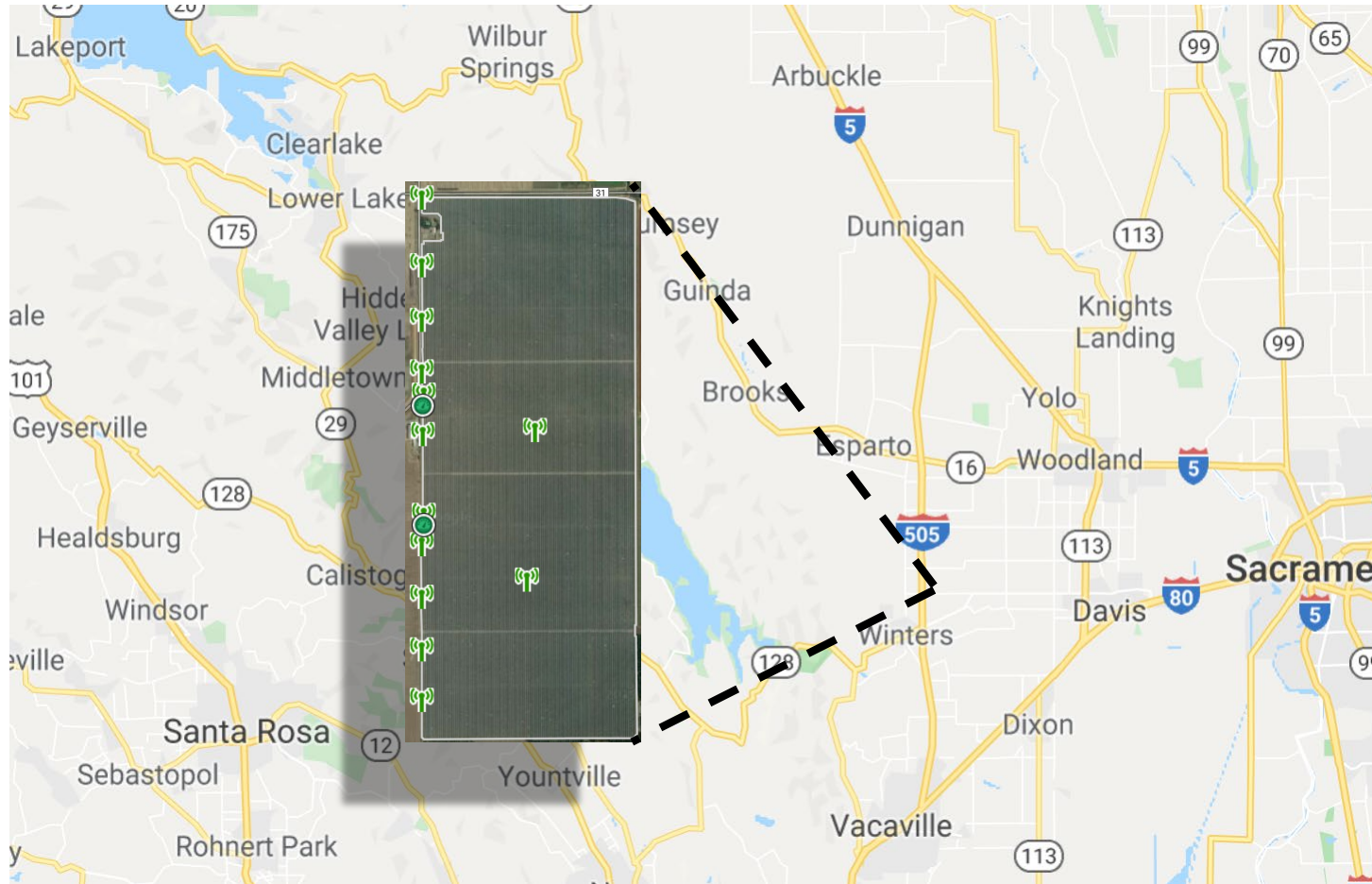
Market is fragmented (ex: Chico region)

County	Top-3 Crop Acres
Butte	198,675
Colusa	215,691
Glenn	168,811
Sutter	136,937
Tehama	50,226
Yuba	63,695
Grand Total	834,035

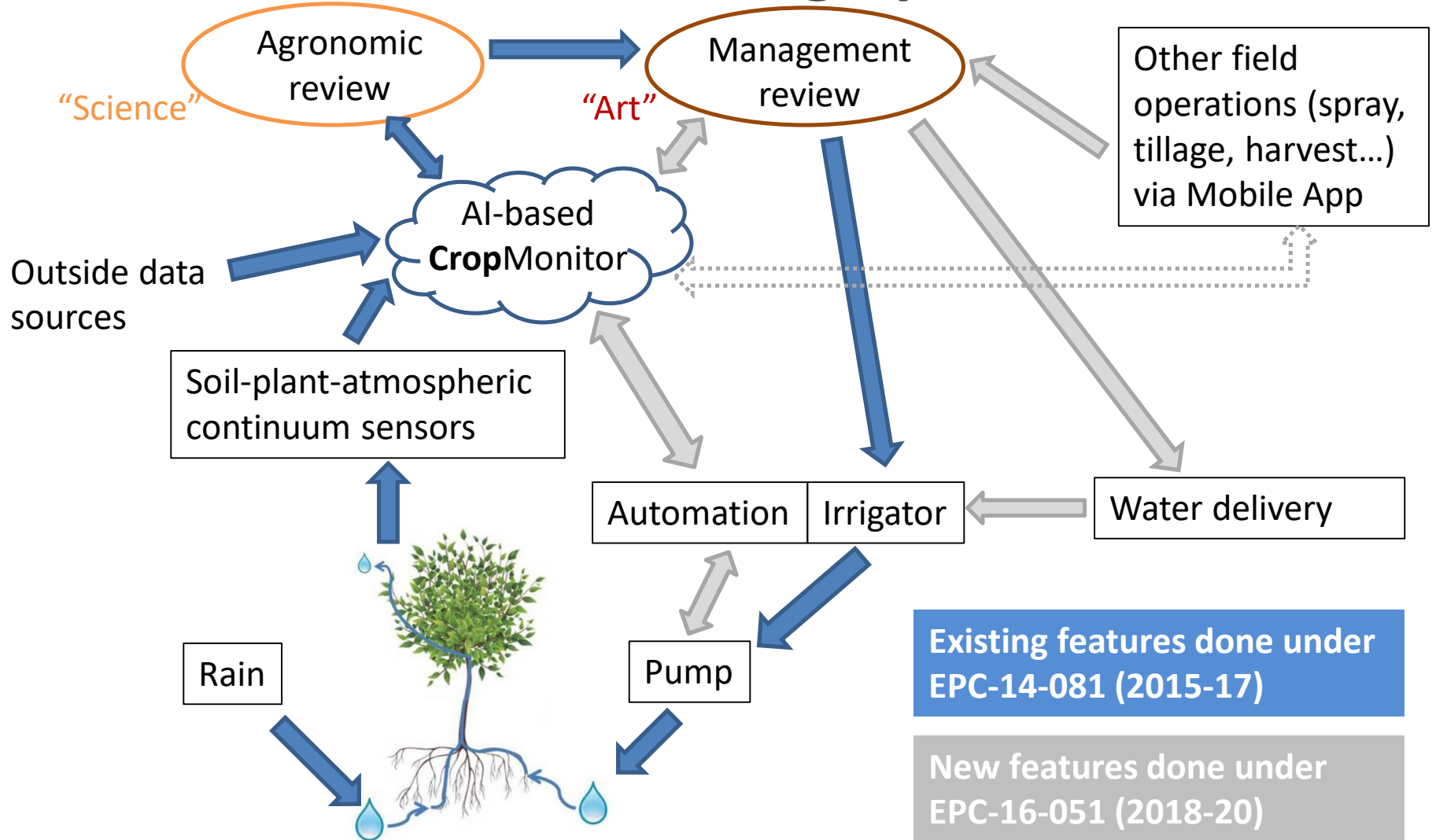


Top 3 crops: Rice, Almonds, and Walnuts

Example: 15,000 acre farm experimenting with automated 388-acre almond orchard



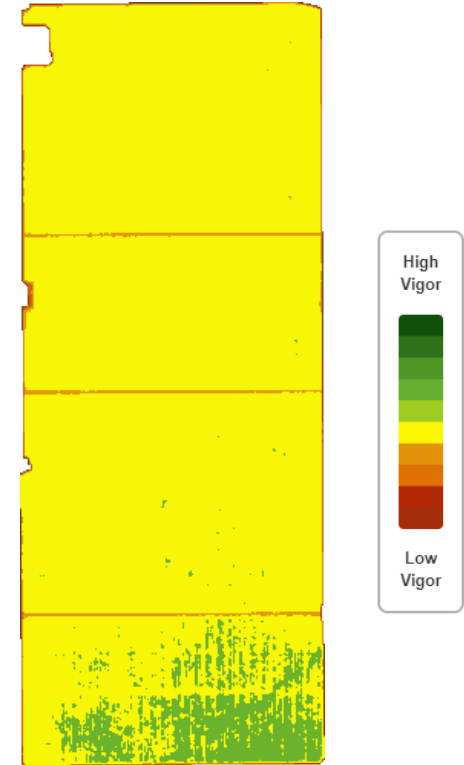
Where does programmable irrigation fit within the farming operation?



Effect of rainfall on orchard with a slope



Image of flooded field near Davis after rain early in the season (near bloom)

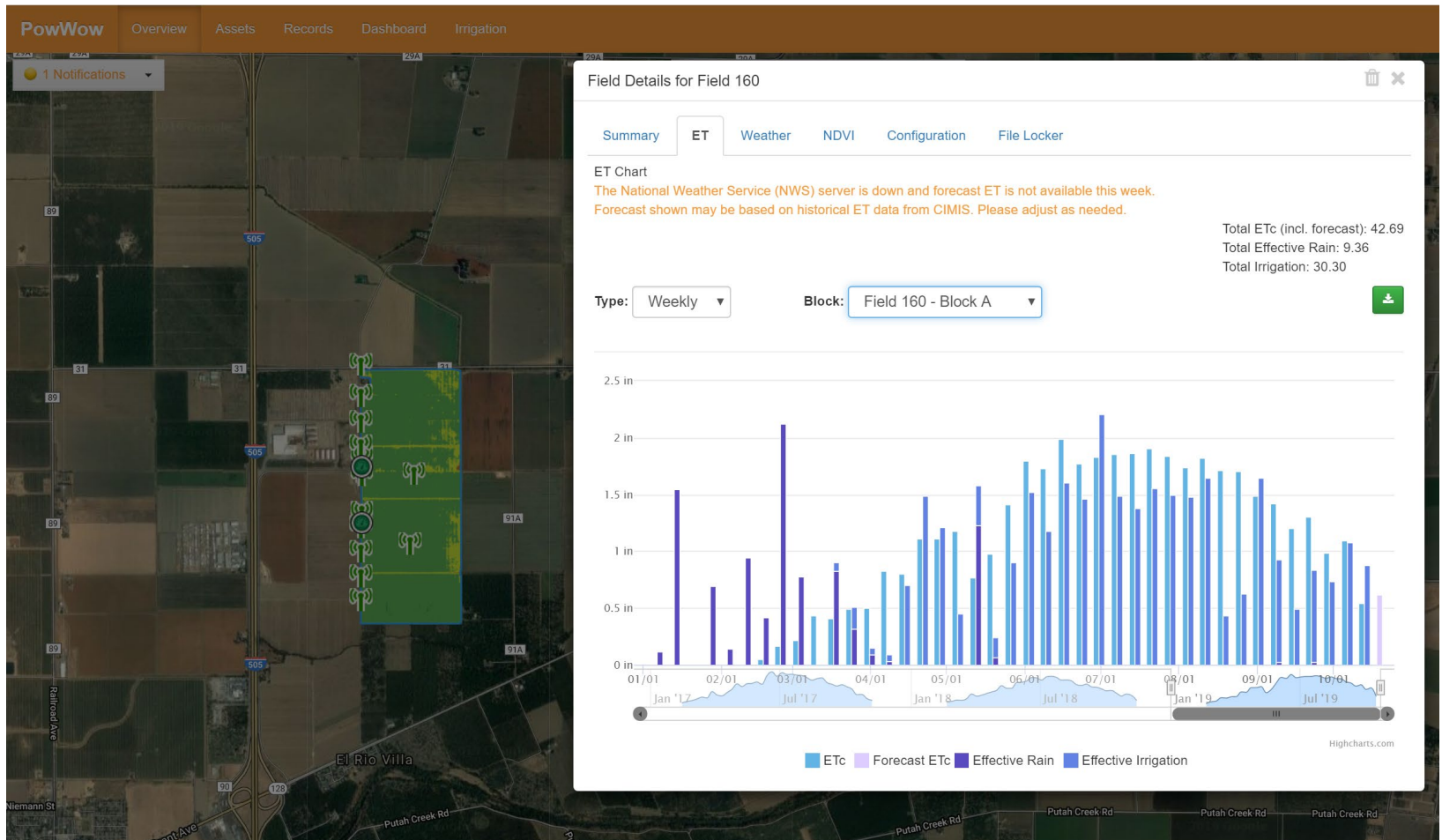


Vigor across field at harvest in 2018 from aerial pictures

Team working on the project near Davis



Screenshot from software dashboard



Water savings: Applied water is 21% less than crop ET. Each block is irrigated differently.

Impact of project on almond orchard

Before

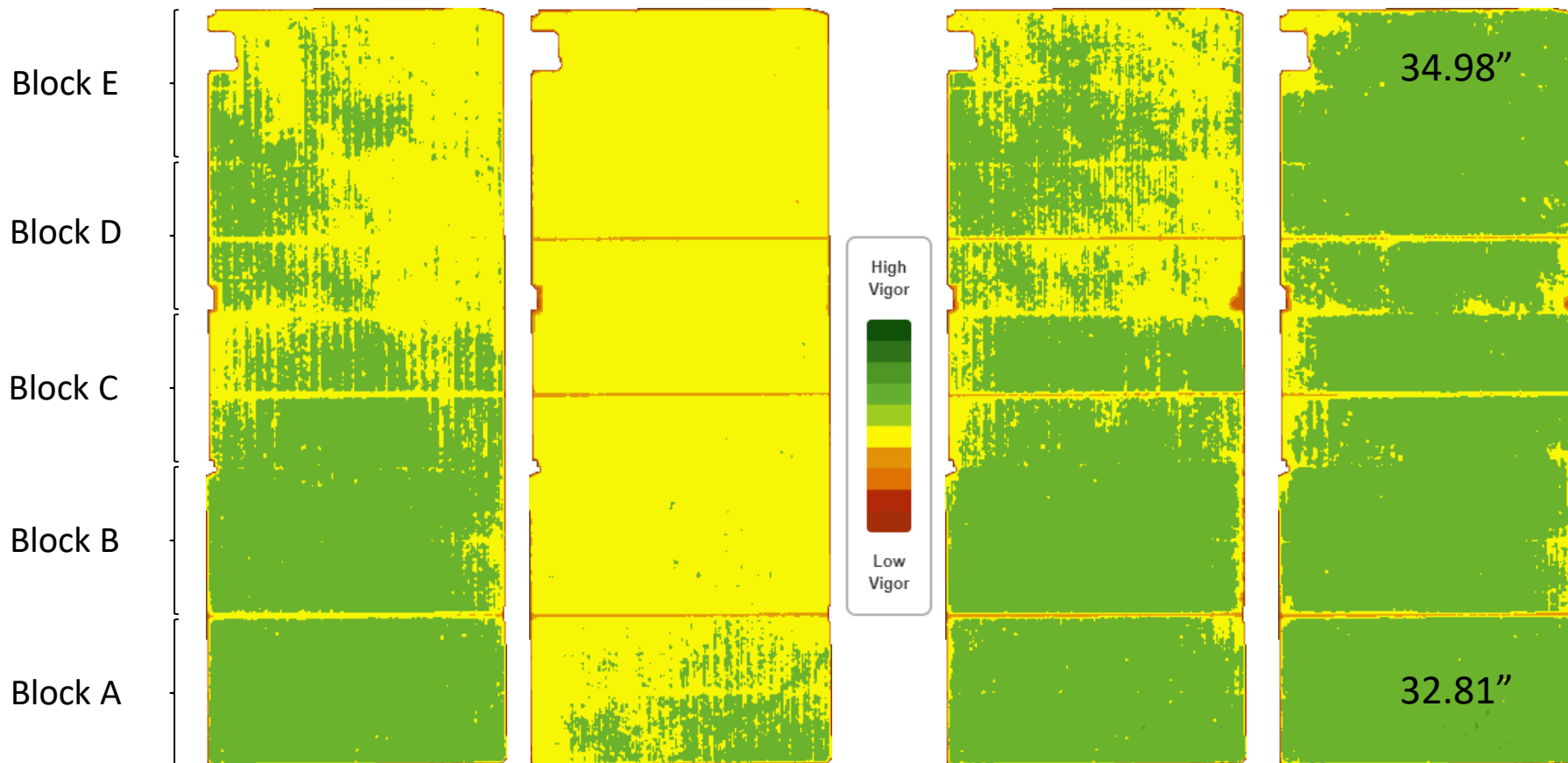
After

June 26, 2018

August 23, 2018

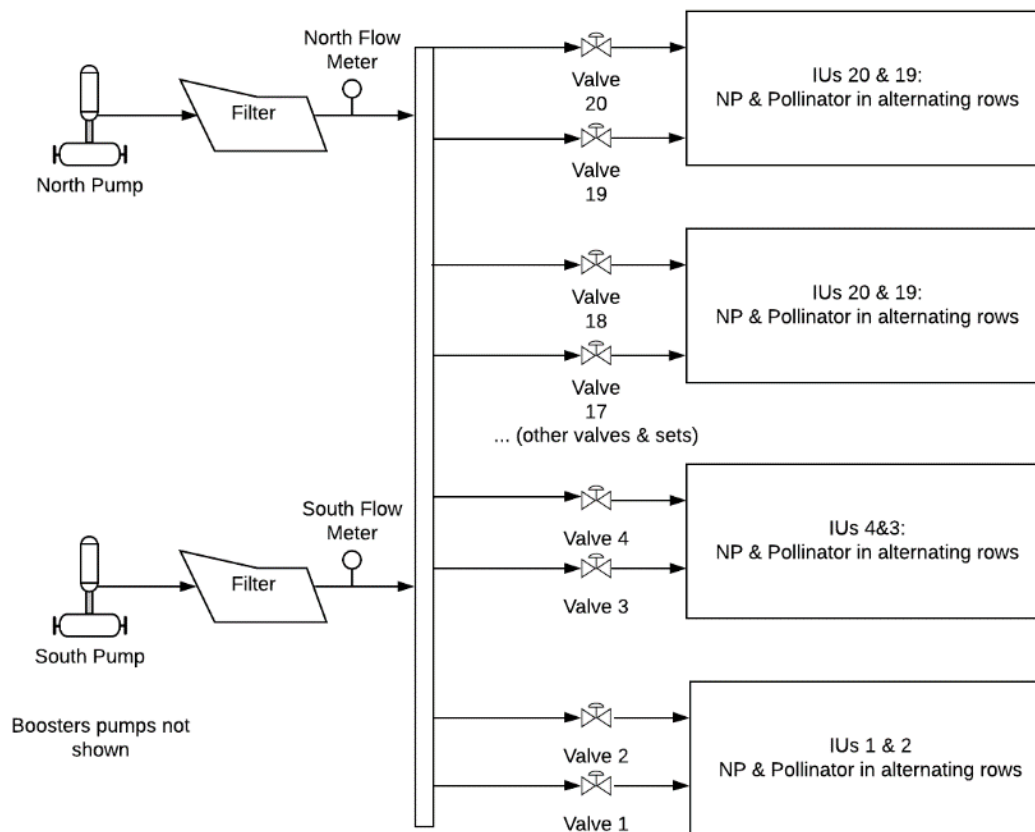
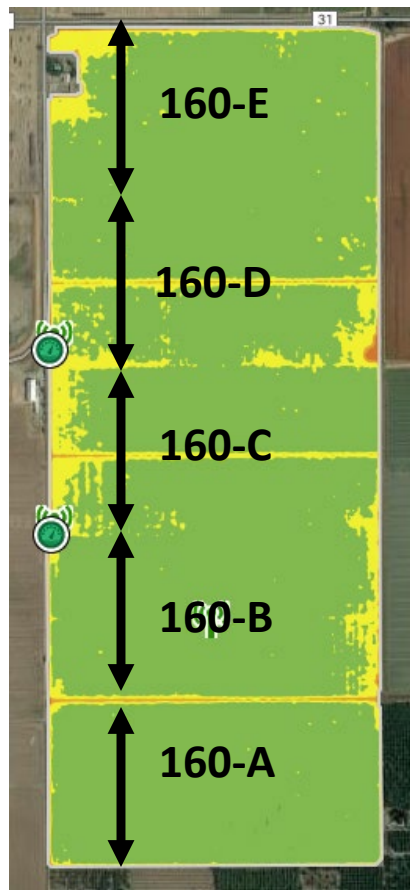
June 19, 2019

August 24, 2019



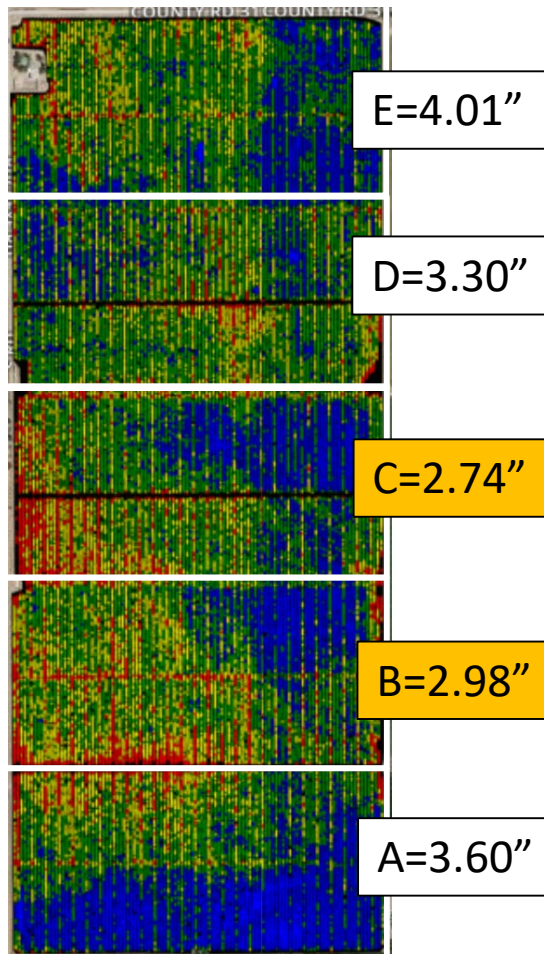
Vigor uniformity dramatically improved. Water applied on Block E is 7% more than on Block A.

Integration is not easy: 20 irrigation units



Overall there are 20 Irrigation Units controlled by individual valves to irrigate by plant variety or soil zone. The opening/closing of valves is staggered to maintain pressure.

Transition to automation can be difficult



- This image illustrates water stress on 6/14
 - ...and irrigation totals for 3 weeks prior
- Some blocks were shorted (B & C) while moving from manual to automation (weeks of 5/27-6/10)

Farming operation will change gradually

Print a work order
or load schedule to
automated field

Week Schedule
Daily Schedule
Automated System Order

Remember to review & send automation commands

Add Activity
Copy Last Week Schedule

Group: 2019 Week 41

Print
New
Refresh
Send

Both manual and automated fields

Ranch	Field	Set Name	Agronomis Hours	Adjusted Hours	Mon 7-Oct	Tue 8-Oct	Wed 9-Oct	Thu 10-Oct	Fri 11-Oct	Sat 12-Oct	Sun 13-Oct	Scheduled Hours	Notes
Almendras del Sol - 215	Field 215	Field 215 (A)	24	24									
Almendras del Sol - 215	Field 215	Field 215 (B)	24	24									
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		2.9	2			5	4.8	5	19:45	
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		3	2.1			5.1	4.8	5.1	20	
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		3	2			5.3		5	15:20	
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		3	2.3			5.3	4.6	5	20:05	
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		3	2			5.4		5	15:25	
Carando Vann Ranch	Field 160	Field 160 (... Automated)	24		3	2			5		5.1	15:05	

CURRENTLY Cameron Boomgaarden of Vann Brothers

Log out

CropMonitor's irrigation workflow

Forecast from Today (9/27/2019, 6:00 am)
Remember to approve the plan. The initial hours are not set in calendar yet

Ranch	Field	Crop	Forecast ETc	Forecast Hours	Set Name	Type	Adjust Inches	Agronomist Inches	Agronomist Hours	Approved Inches	Approved Hours	Notes
Automation Demo	Field 1	Almonds	0.82	20	Field 1 (Automated)	Drip	0.1	0.92	22			
Automation Demo	Field 2	Almonds	0.45	11	Field 2 (Automated)	Drip		0.45	11			
Automation Demo	Field 3	Almonds	0.45	11	Field 3 (Automated)	Drip	-0.1	0.35	9			

Agronomic review
feeds into...

Remember to review & send automation commands

Ranch	Field	Set Name	Agronomist Hours	Manager Hours	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Schedule Hours	Notes
Automation Demo	Field 1	Field 1 (Automated)	22	22								24	
Automation Demo	Field 2	Field 2 (Automated)	11	11								11	
Automation Demo	Field 3	Field 3 (Automated)	9	9								9	

Scheduling
by manager

Irrigation
events...

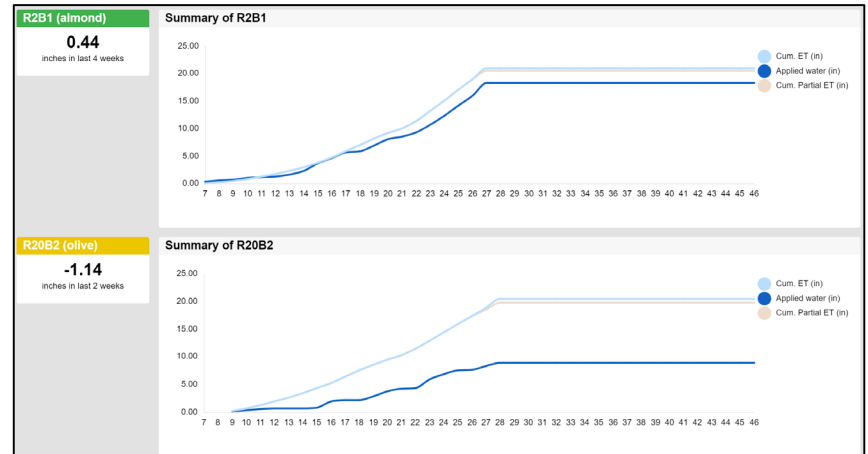
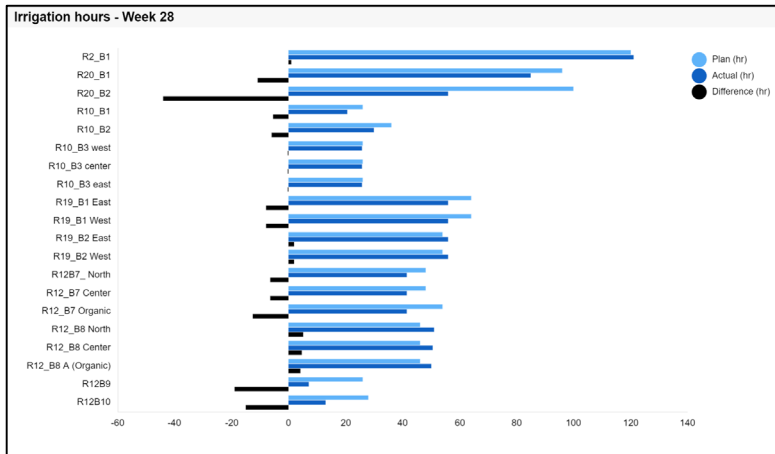
Accuracy
report for
Agronomist

Precision
report for
management

Precision and accuracy reports

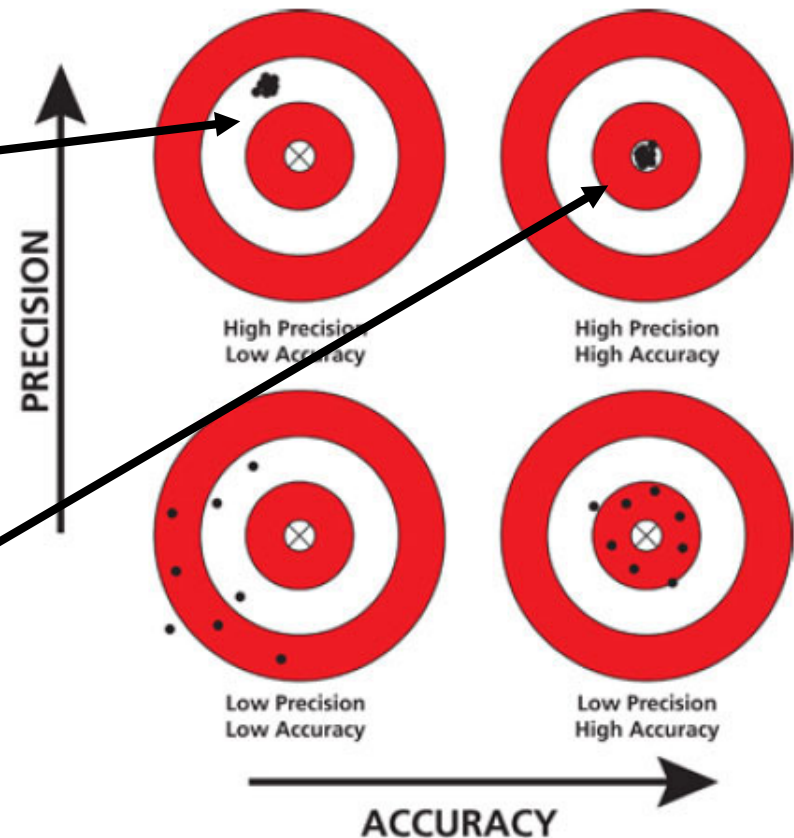
Precision (hours) – are we following the plan?

Accuracy (inches) – are we meeting the crops needs?



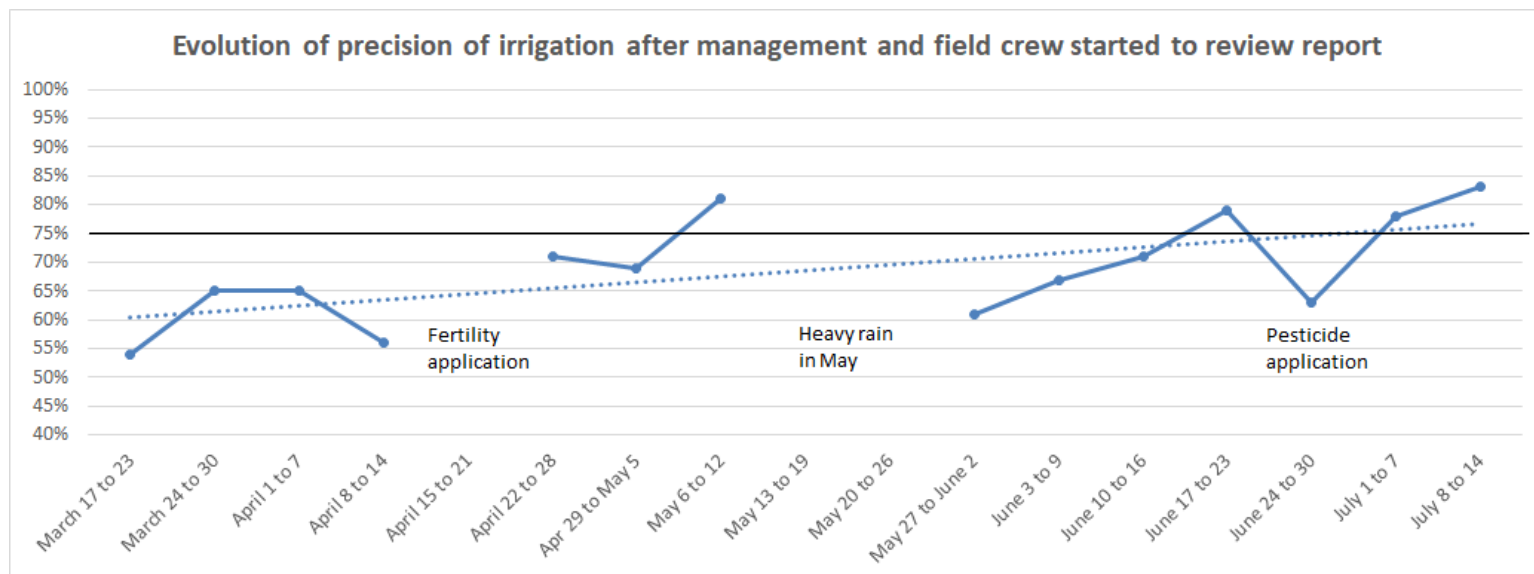
Precision vs Accuracy in irrigation

- **Precision** – A farm must be able to follow a plan (tight cluster)
- **Accuracy** – Feedback from sensors and yield data help accurately tune the plan (bullseye) for the most “crop per drop”



Precision: value for farms large and small

- Precision report is not just for large farms: it triggers important conversations with smaller organizations to improve farming practices and gain efficiency in the future (example below)
- Farms with extensive automation will still benefit from precision reporting: irrigation events are paused/canceled in the field
- **All farms** benefit from greater visibility within the organization



Answers, not just data



Optimize your water and energy.
Grow better food.

PowWow provides a farming decision-support tool that leverages machine learning to solve practical problems in agriculture. It is perfectly suited for growers who want to increase their profit margins and pass a sustainable farm onto the next generation.

