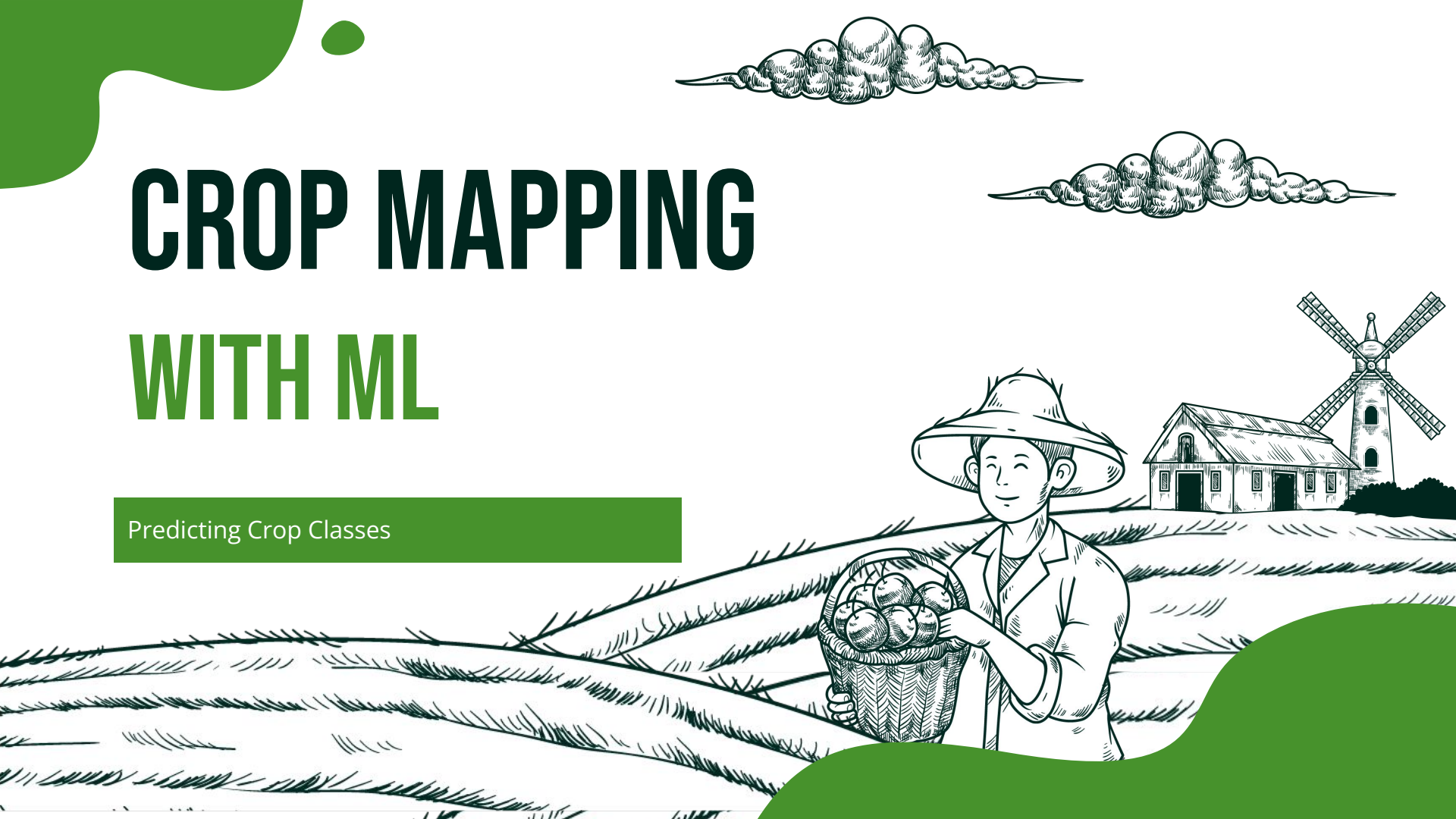


CROP MAPPING WITH ML

Predicting Crop Classes



PROCESS



01

**PROBLEM
STATEMENT**

02

**DATA
MANIPULATION**

03

**CLASS
PREDICTION**

04

**FRONT
END**





WHAT IS GROWING?

We would like to know what is being grown where, without having to ask each farmer what they are growing.

- We know a variety of parameters for the area
- We know the location of each field
- A relation can be found between certain parameters and the crop that is being grown

If we can accurately describe what is being grown on each field based on these parameters, then we can integrate a map into a website that displays the fields and what crops they hold.





01

PROBLEM STATEMENT





PROBLEM STATEMENT



CROP LABELING

Does the sensor data given such as ET correlate to certain crops?
Can we predict what kind of crops are in a field based on that data?



CROP MAPPING

If we are able to tell from sensor data what crop is being planted, then we need to be able to visually show where these crop groups are so that informed decisions about resource management can be made.



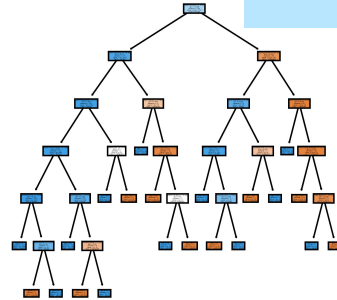
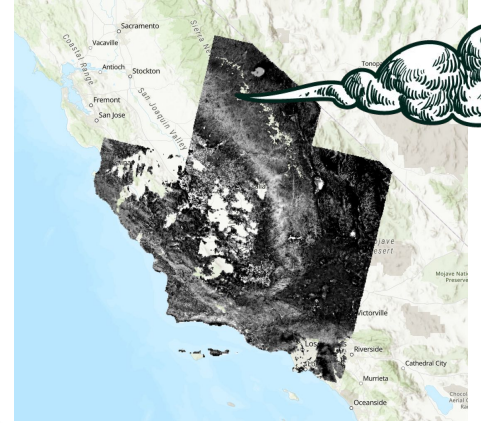
OUR APPROACH

ML MODEL

To tell what crop group a unknown crop is in from given data we used a random Forest

DATA VISUALIZATION

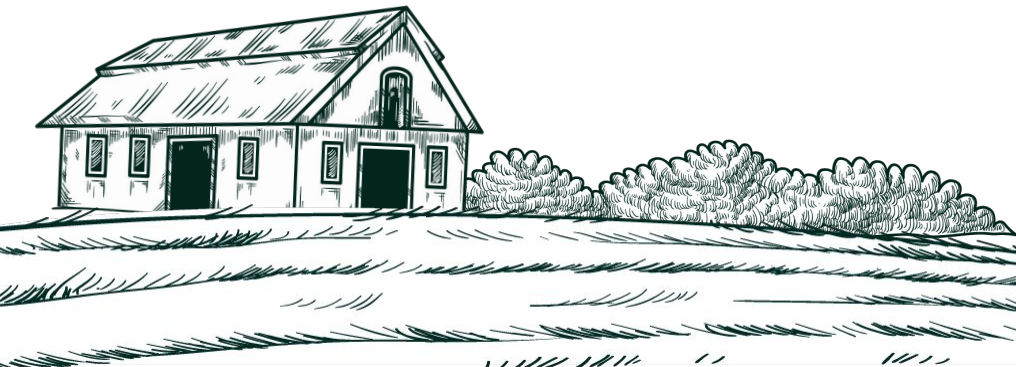
To visually display the now known crops, we can use ArcGIS Online to create a web map or use their ESRI Leaflet Developer Platform.





02

DATA MANIPULATION



DATA MANIPULATION PROCESS

DOWNLOAD



STEP 1

Gather data set

COPY DATA



STEP 2

Extract mean values of
all 6 variables

DELETE



STEP 3

Clean data set for
useful data points

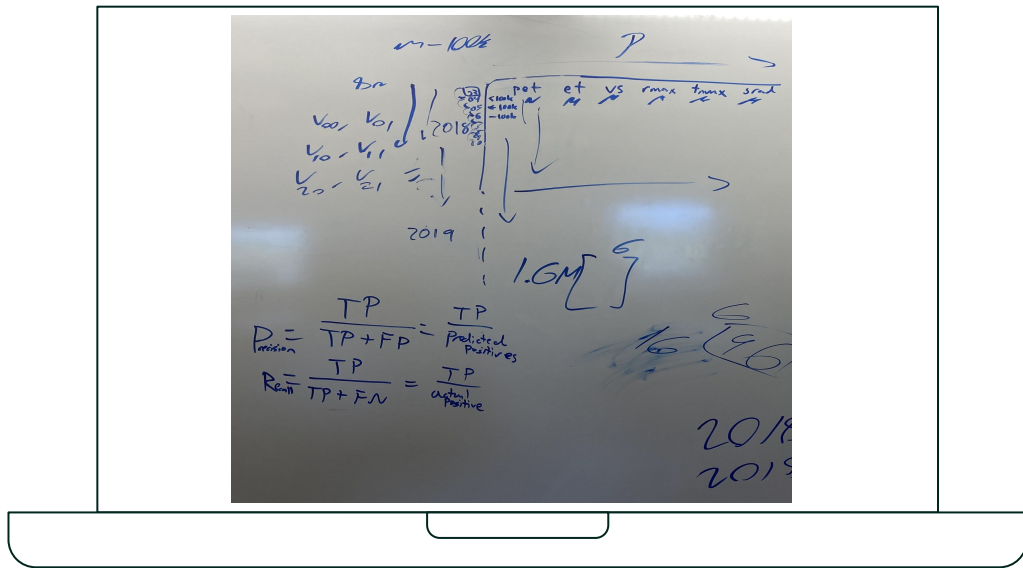
REPEAT



STEP 4

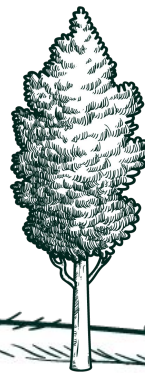
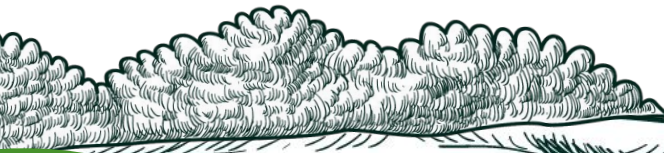
Combine data into a
single file





ORGANIZING DATA

This drawing shows how we organized data on spreadsheets: 1.6M data points for each of 6 variables





03

CLASS PREDICTION



RANDOM FOREST MODEL DEVELOPMENT

PANDAS



STEP 1

Put in data from previous step to pandas Dataframe

DATA SPLIT



STEP 2

Split data into input, output, training and testing sets

RANDOM FOREST



STEP 3

Sets up random forest classifier model

ACCURACY



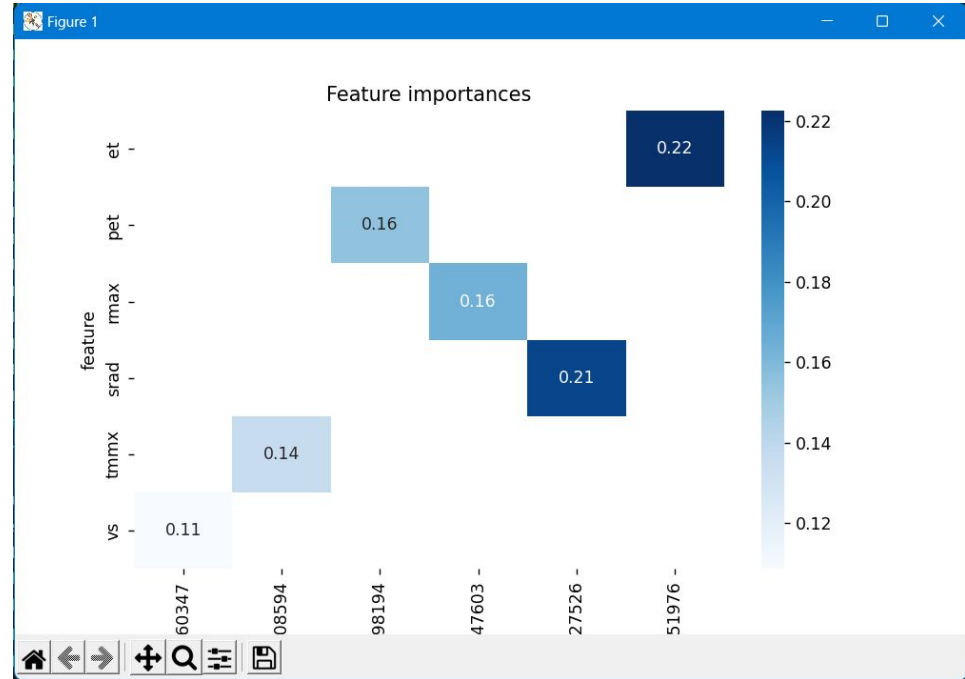
STEP 4

Trains data, then evaluates accuracy with testing data



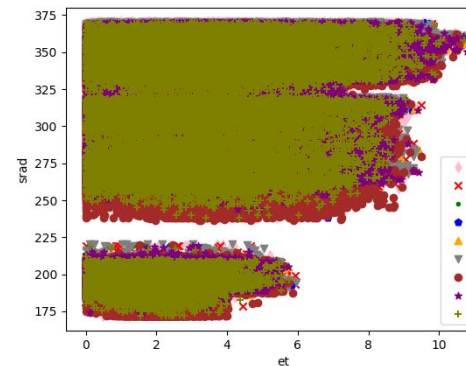
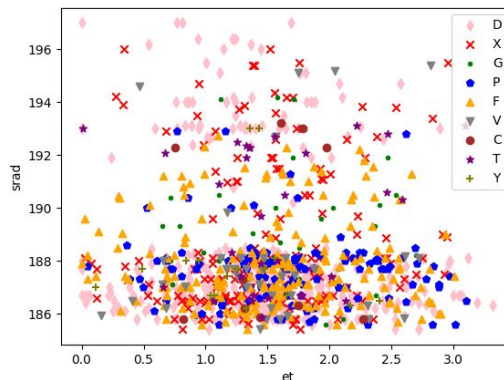
INPUTS

- Random Forest Model takes 6 averaged parameters
 - vs
 - tmmx
 - srad
 - rmax
 - potential et
 - Et
- These parameters are present in each of the ~100k field samples



DATA SPREAD

- There is a visible and significant overlap of the data along the heaviest parameters
- This makes any sort of categorization hard
- More relevant variables might be necessary to help further improve the accuracy of the model

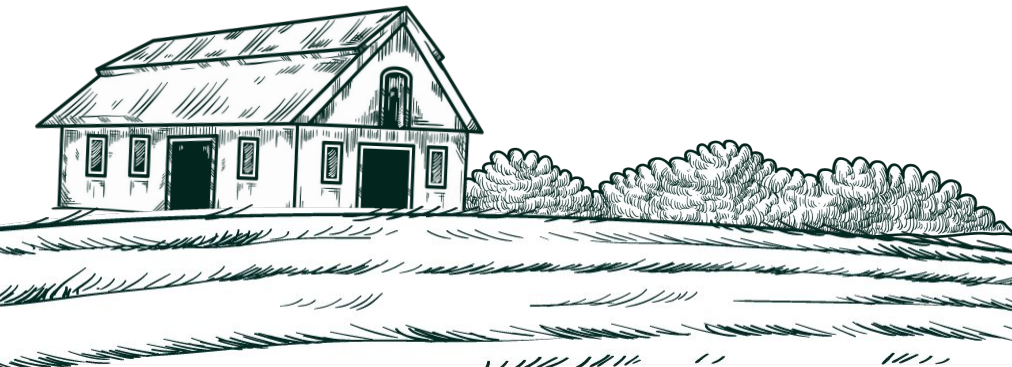


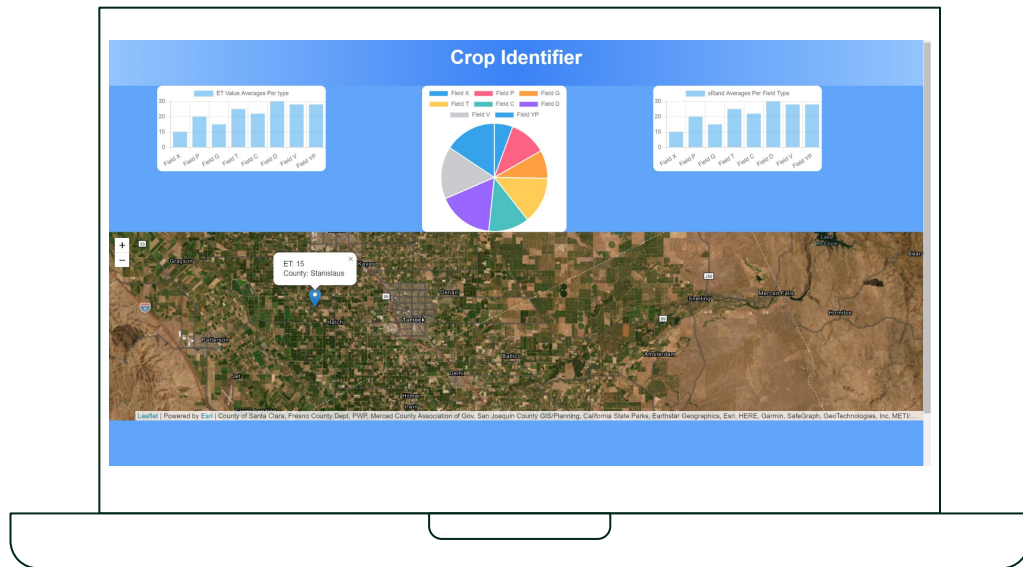
Depth: 20		Accuracy: 0.5298311173009105			
		precision	recall	f1-score	support
	C	0.67	0.81	0.73	55586
	D	0.52	0.71	0.60	88843
	F	0.45	0.44	0.45	22332
	G	0.30	0.06	0.10	9567
	P	0.26	0.07	0.11	12294
	T	0.42	0.33	0.37	18558
	V	0.50	0.57	0.53	40547
	X	0.42	0.16	0.24	32938
	Y	0.32	0.03	0.05	9418
	accuracy			0.53	290083
	macro avg	0.43	0.35	0.35	290083
	weighted avg	0.50	0.53	0.49	290083



04

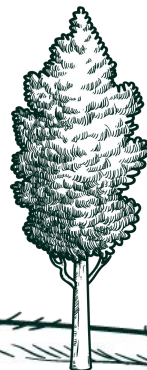
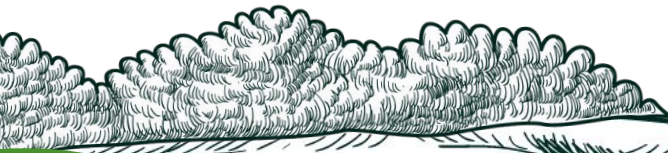
FRONT
END





CROP MAPPING WEBSITE

This website will display the outcomes from our generated model to show what crops are in which farmlands

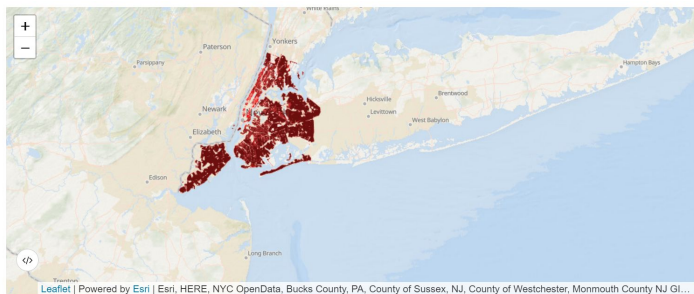




WEBSITE - MAP INTEGRATION

LEAFLET/ARCGIS

LEAFLET TILE MAPPING



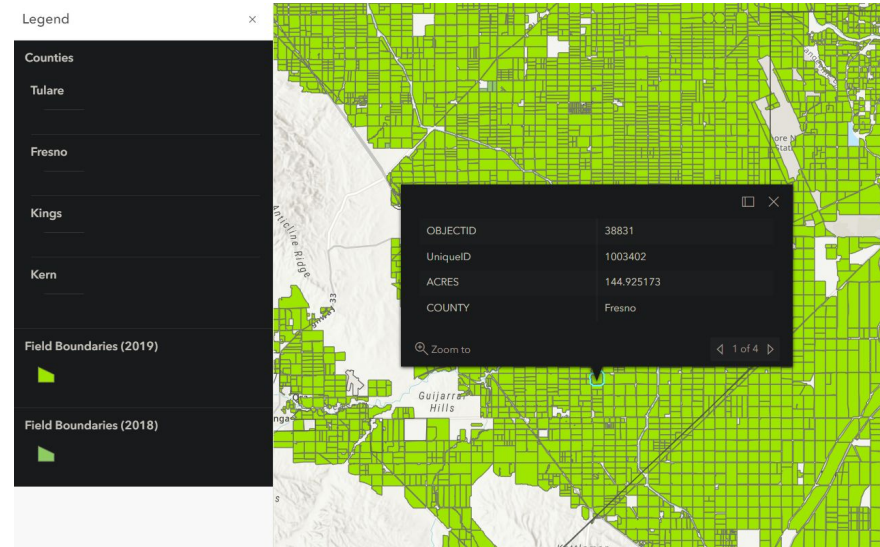
ARCGIS



CHALLENGES AND FUTURE IMPROVEMENTS



- Model limitations
 - Accuracy always hovered around 50%
- Time limitations
 - Disparate parts that can be combined
- Scalability
 - Inefficient to check every field
 - Symbology based on crops
- Website integration
 - Currently locally hosted
 - Embedded maps



THANK YOU

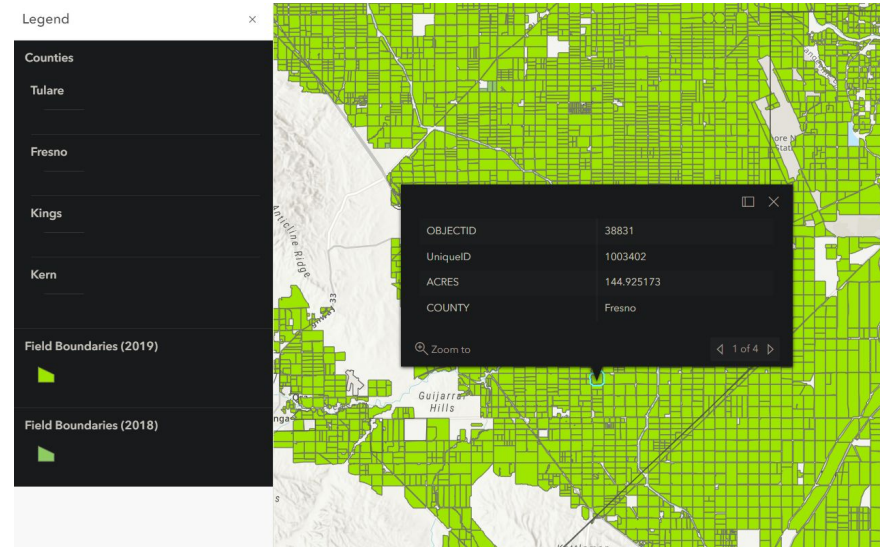
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EVAPOINSPIRATION: CROP MAPPING WITH ML



- What we did
 - We created a model that predicts fields' crop class
 - We created a website that takes the predictions mapping them to their respective fields
- Future Plans
 - Explore other Models
 - Combine classification with time series forecasting
 - Consider more variables
 - Economics
 - Connect predictions to website
 - Open access website
 - Fine tune Accuracy



UC Merced Computer Science & Engineering

Carolyn Cui, Luis Fujarte, Yulin Lin, Ryan Milstrey*, Joshua Tapia

*and Applied Math

