Cover Crops – Are We Getting What We Pay For?

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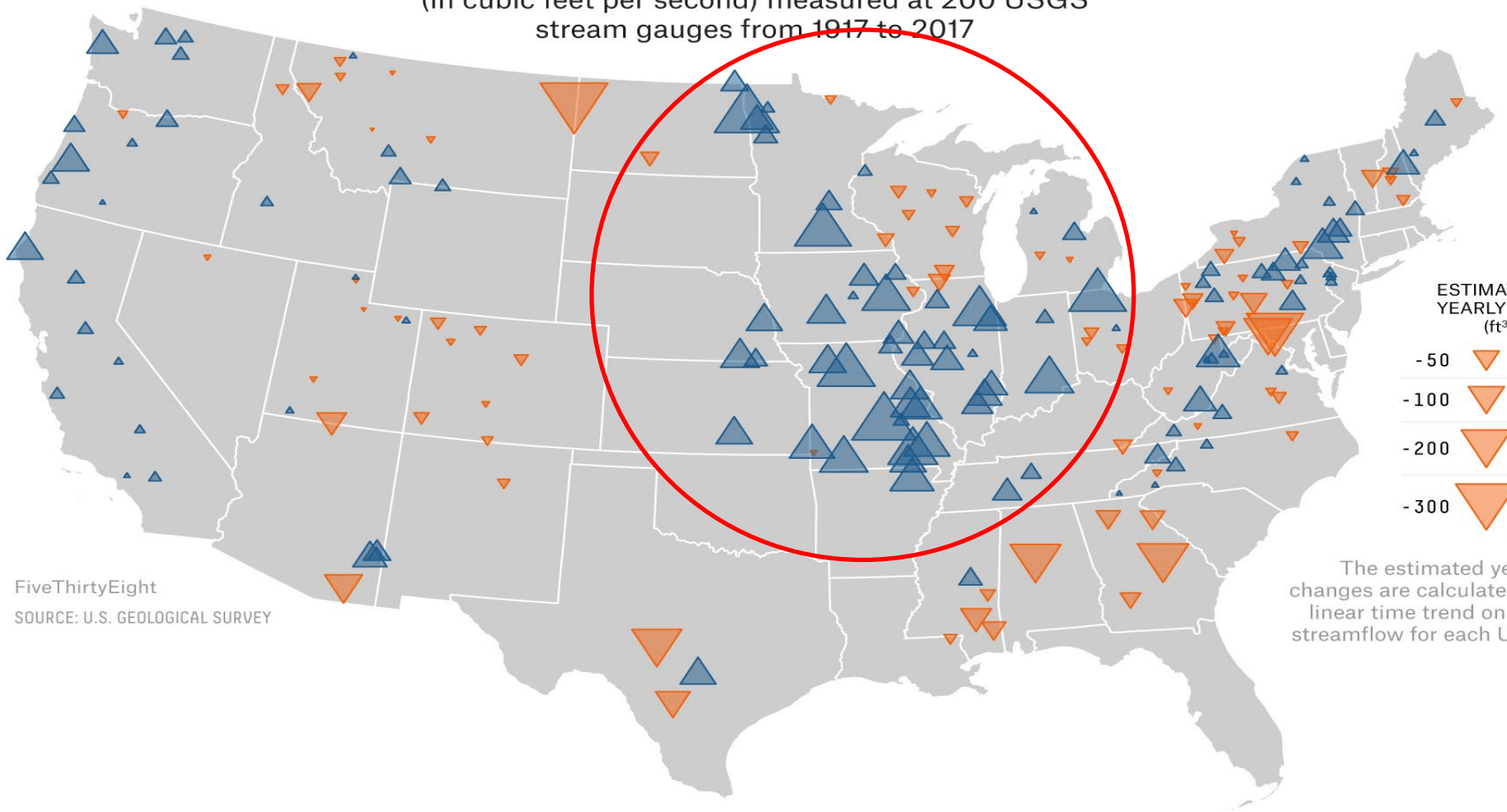
Source: Iowa Beef Center

The Midwest is getting wetter

Estimated average yearly change in peak flow of water (in cubic feet per second) measured at 200 USGS stream gauges from 1917 to 2017



Source: USGS - FiveThiryEight

Mississippi River Drainage Basin

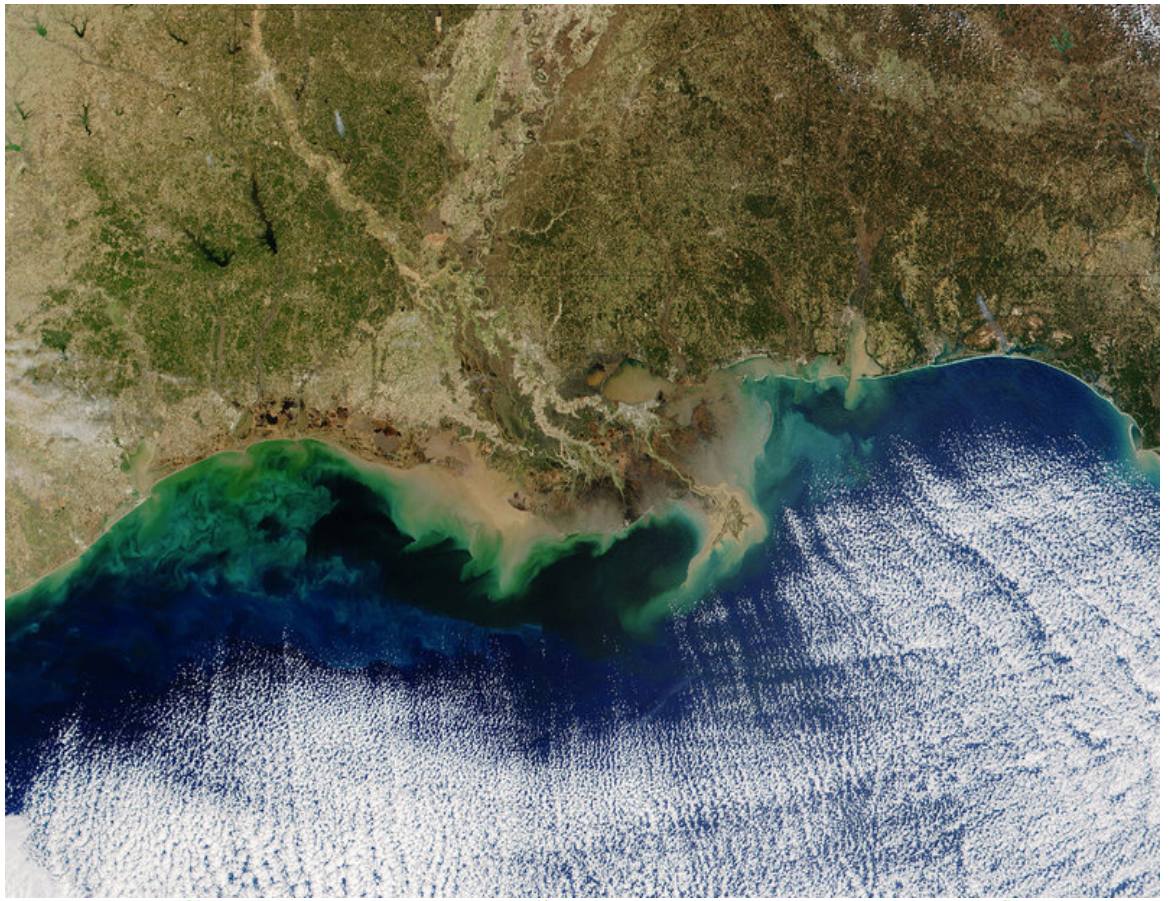
Mississippi Closes Beaches Because of Toxic Algae Blooms

The New York Times

By Christine Hauser

July 8, 2019

Mississippi has closed all of the state's beaches to swimming and other water recreation, like this one in Ocean Springs. RooM the Agency Mobile/Alamy



Source: NASA – Getty Images

Cover Crop Solution

What are cover crops…

- Typically cold season grasses or legumes
- Planted on cultivated fields during the spring and fall when they are absent of a cash crop

Source: USDA - NRCS

Source: Minnesota Corn Growers Association

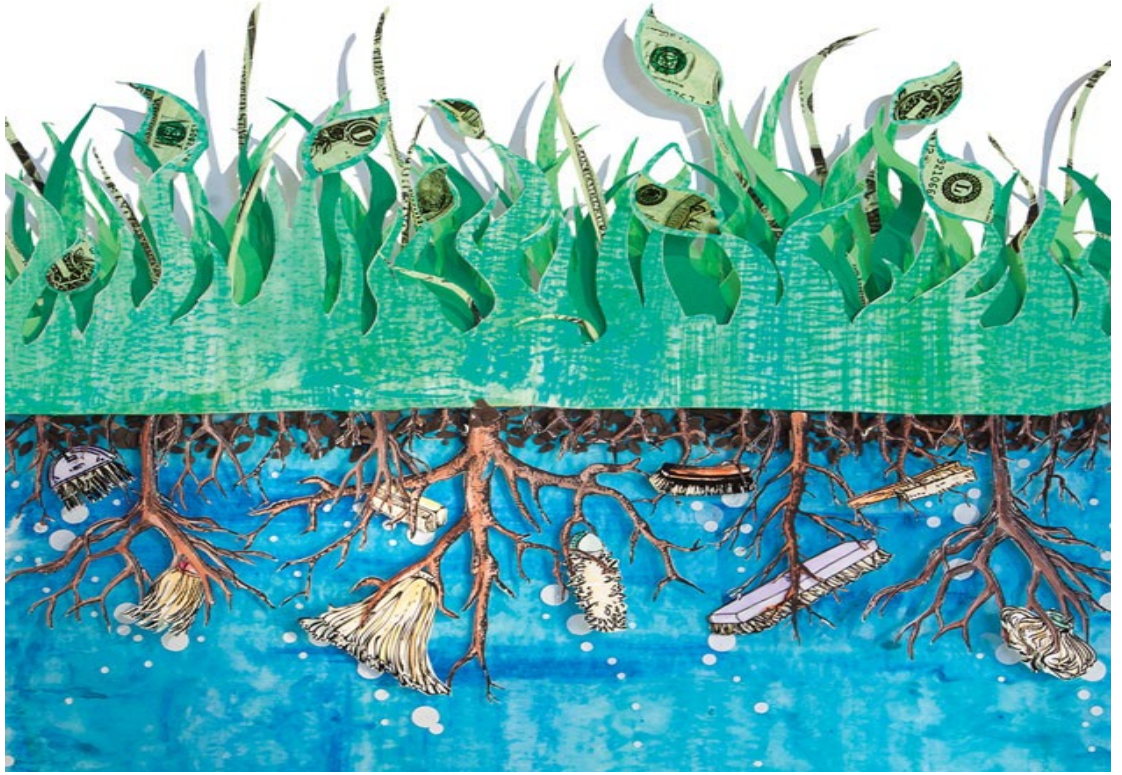
Source: Union of Concerned Scientists

Cover Crop Benefits

How are they helping…

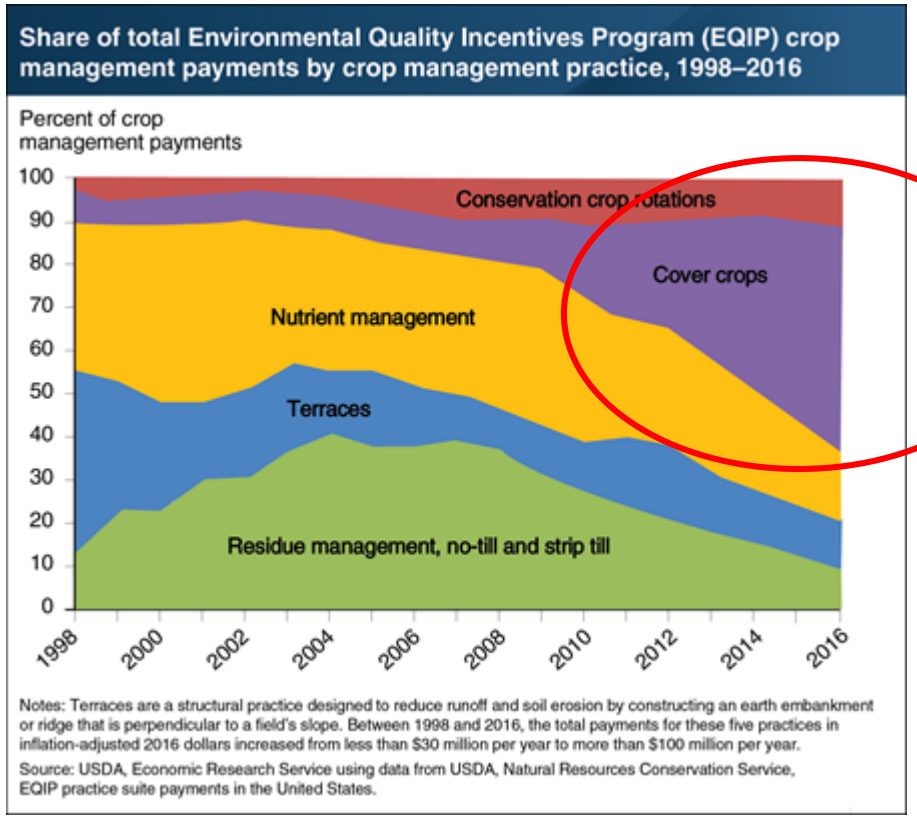
- Cut fertilizer costs
- Reduce the need for herbicides
- Improve yields by enhancing soil health
- Prevent soil erosion
- Conserve soil moisture
- Protect water quality

Source: Sustainable Agriculture Research & Education

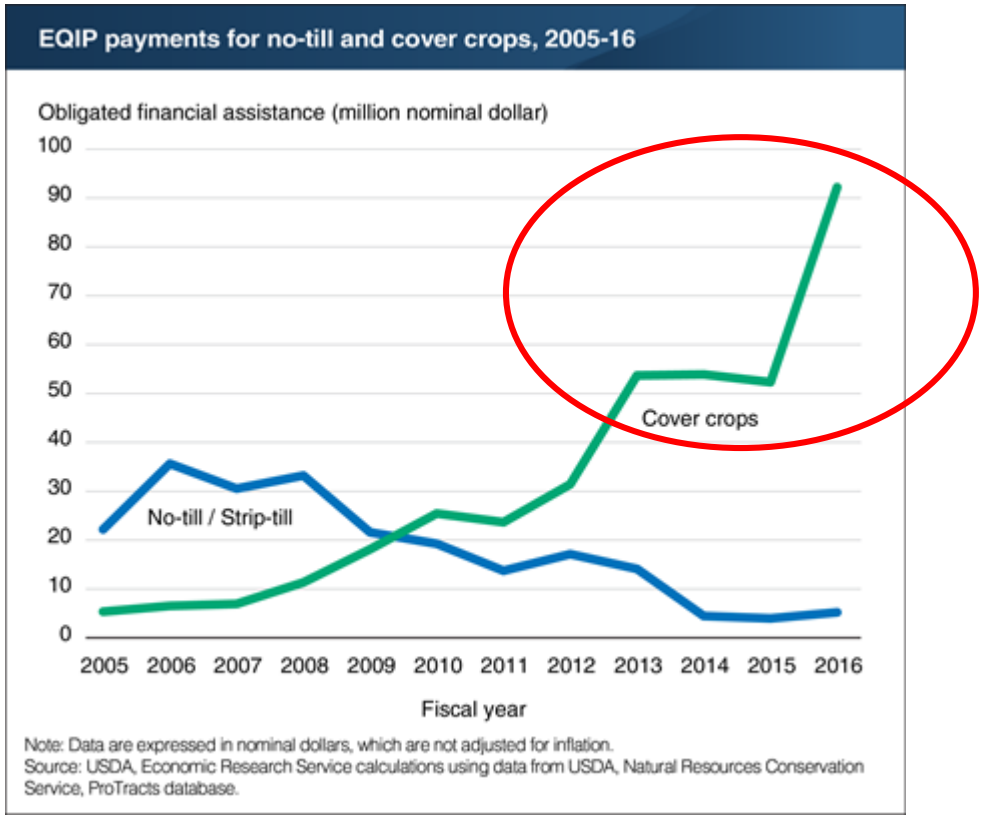


Source: Mother Jones

Practice Adoption Investment

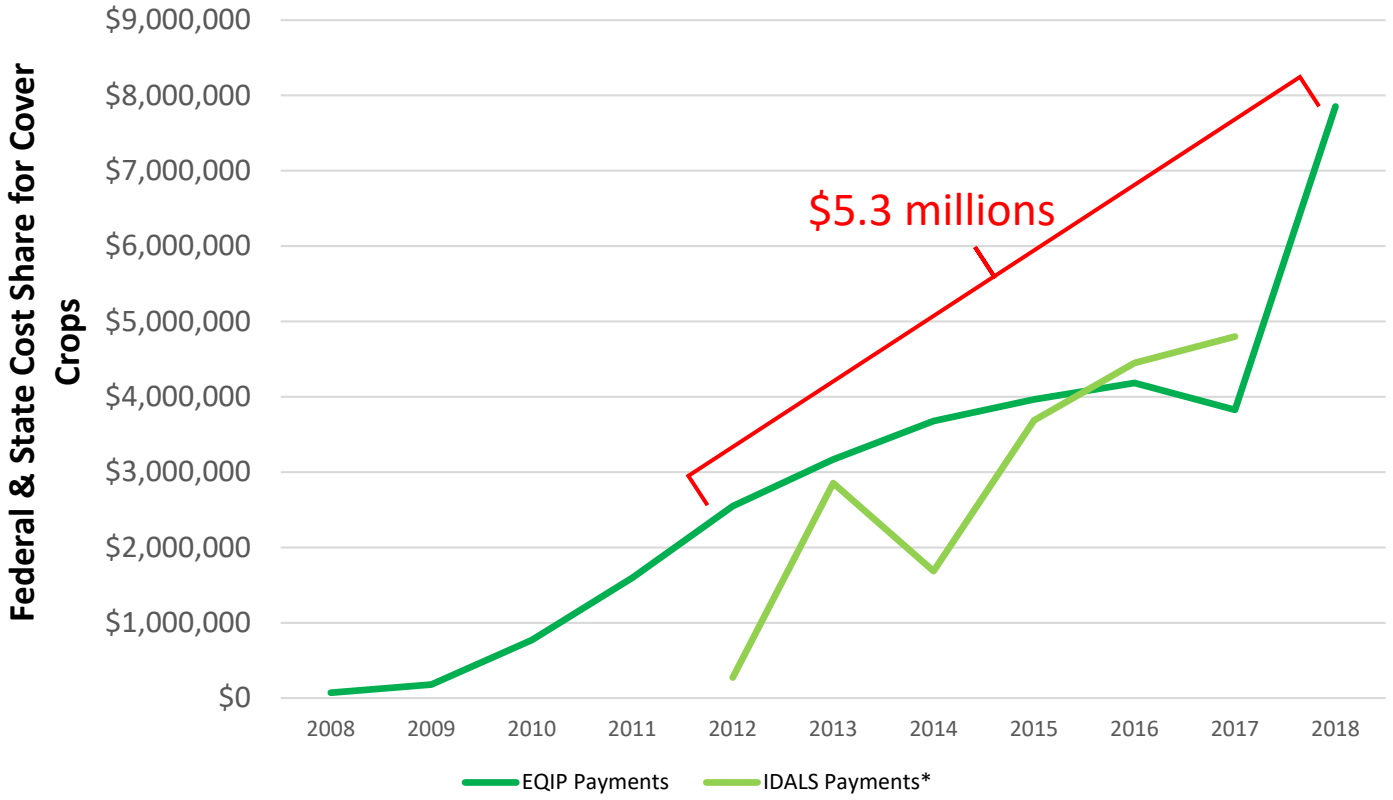


Source: USDA – Economic Research Service



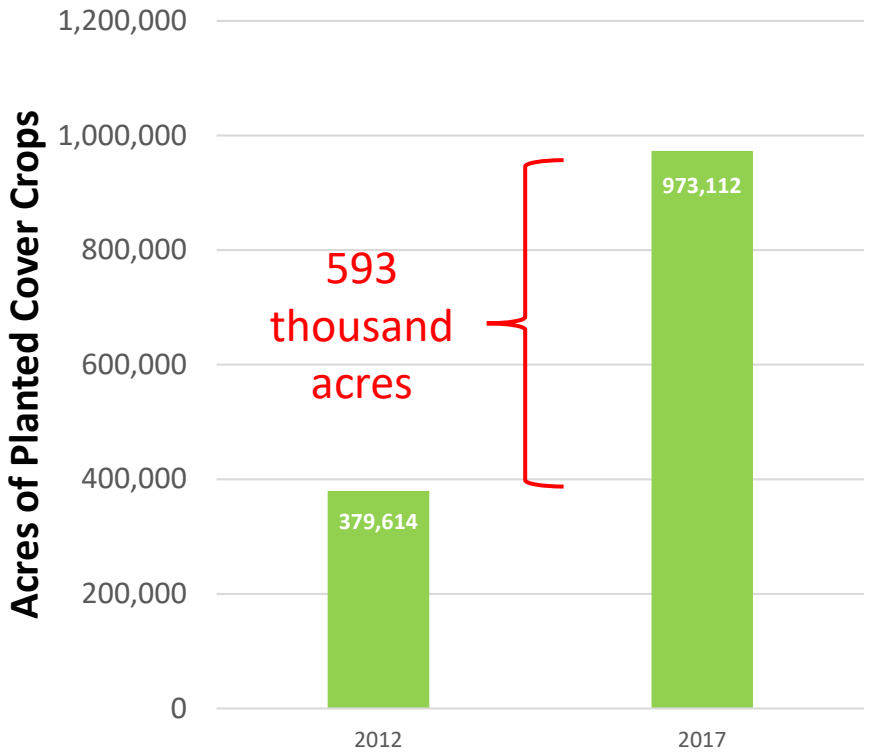
Source: USDA – Economic Research Service

Iowa Cover Crop Investment



Source: Iowa Dept. of Agriculture and Land Stewardship & Environmental Quality Incentives Program

*Assumes $20 an acre cost share



Source: USDA – Census of Agriculture

Objectives

This capstone project will:

- **Measure** the cover crop growth tied to cost share as a proxy for adoption in Iowa.

- **Evaluate** effectiveness related to reducing nutrient runoff from fields more susceptible to erosion over a five-year period in Iowa.

GROWTH - Quantity

1) Cover crop area of time
2) Overlapping areas
3) Spatial distribution of the practice (neighbors)

EFFECTIVENESS - Quality

1) Cover crops planted on areas prone to erosion
2) Cover crops proximity to vulnerable landscapes
3) Cover crops within cash crop rotation

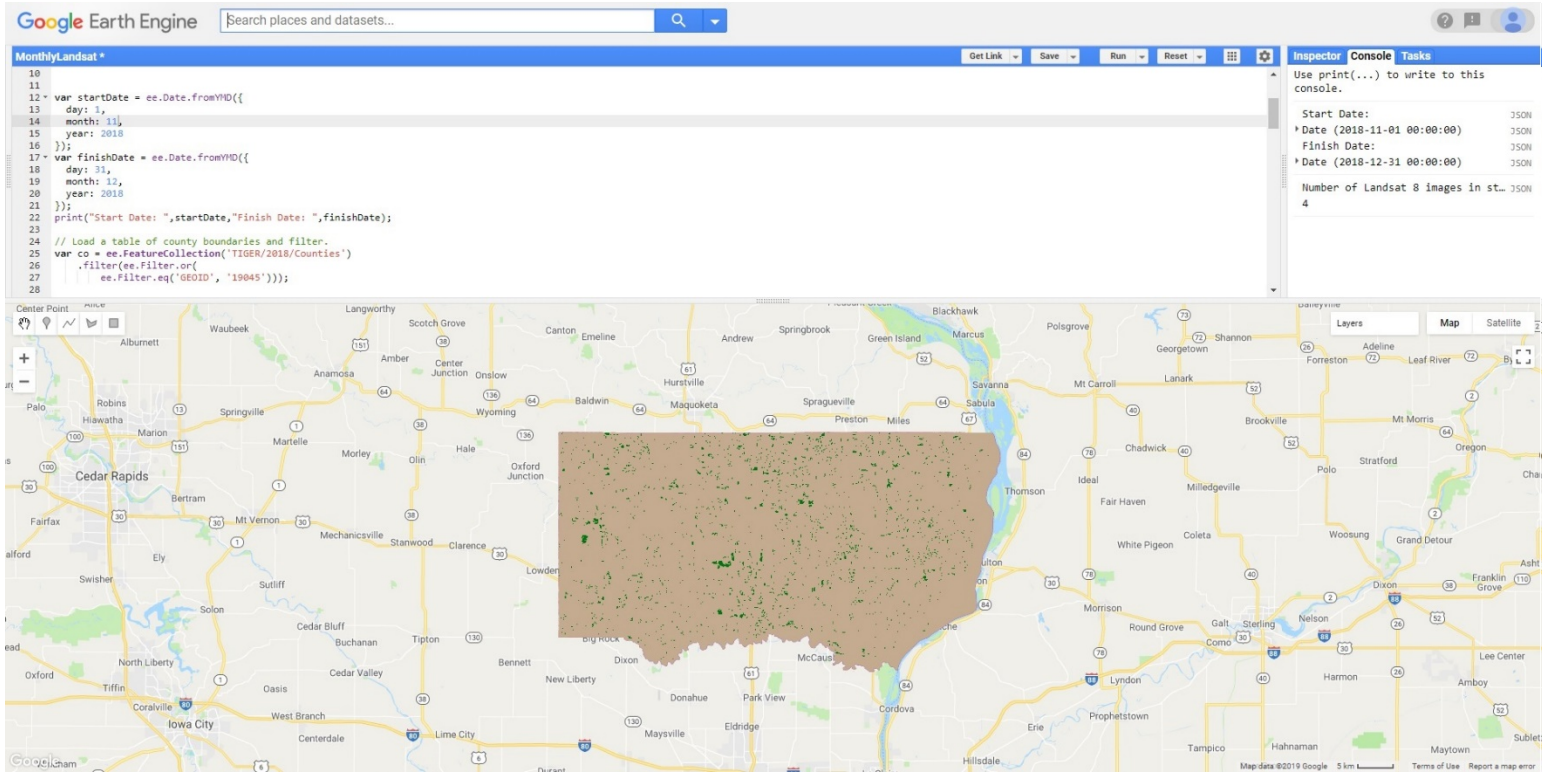
Remote Sensing with Google Earth Engine

Fast – leverage Google's cloud computing to analyze imagery in seconds

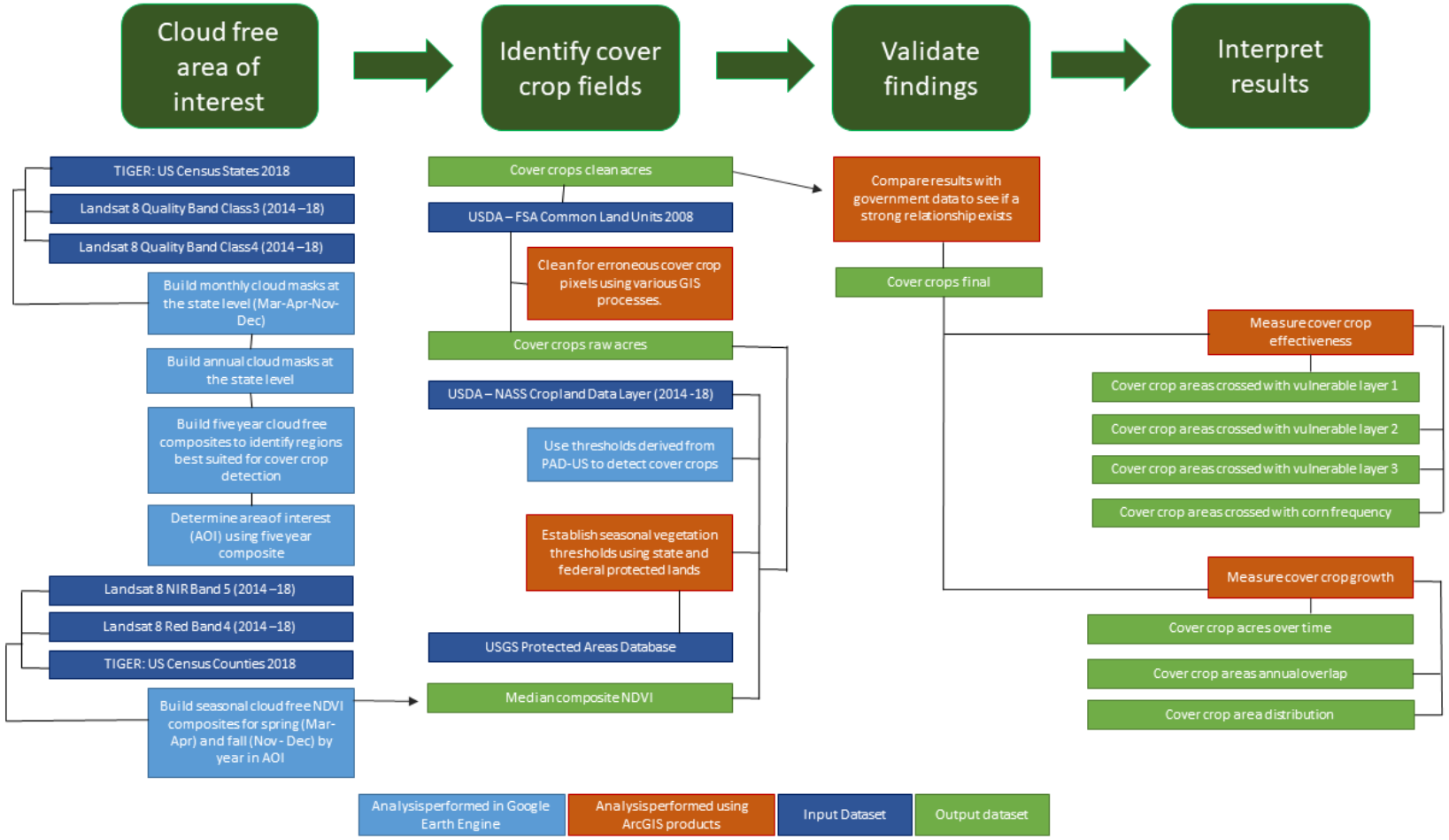
Catalog – access imagery (atmospherically corrected) and many other dataset

Algorithms – perform raster math and other analyses on the fly

Customizable - Easy to automate process with JavaScript



Project Workflow



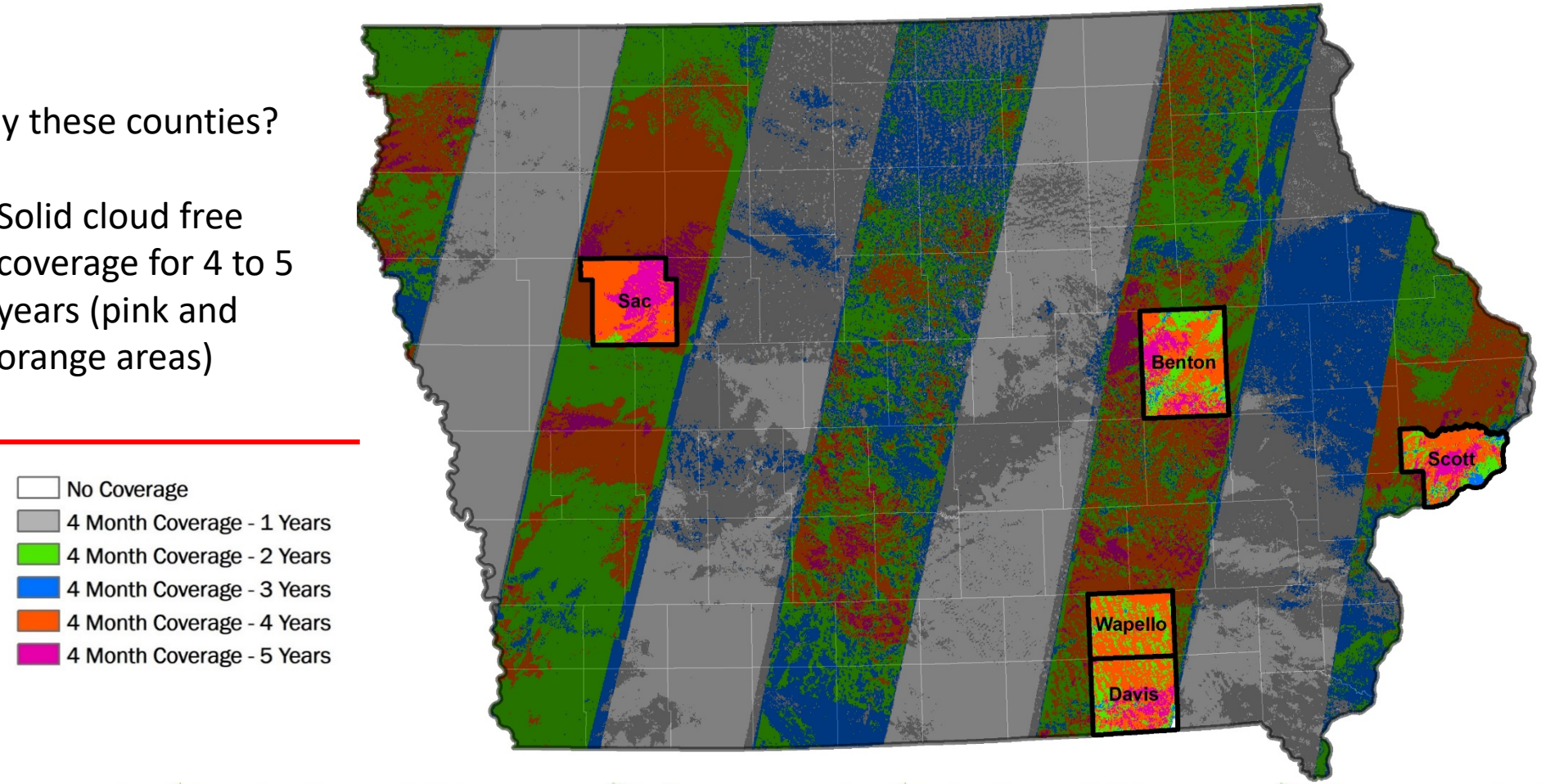
Define an Area of Interest in Iowa

Cloud free area of interest

- TIGER: US Census States 2018
- Landsat 8 Quality Band Class3 (2014 –18)
- Landsat 8 Quality Band Class4 (2014 –18)
- Build monthly cloud masks at the state level (Mar-Apr-Nov-Dec)
- Build annual cloud masks at the state level
- Build five year cloud free composites to identify regions best suited for cover crop detection
- Determine area of interest (AOI) using five year composite
- Landsat 8 NIR Band 5 (2014 –18)
- Landsat 8 Red Band 4 (2014 –18)
- TIGER: US Census Counties 2018
- Build seasonal cloud free NDVI composites for spring (Mar-Apr) and fall (Nov - Dec) by year in AOI

Why these counties?

- Solid cloud free coverage for 4 to 5 years (pink and orange areas)

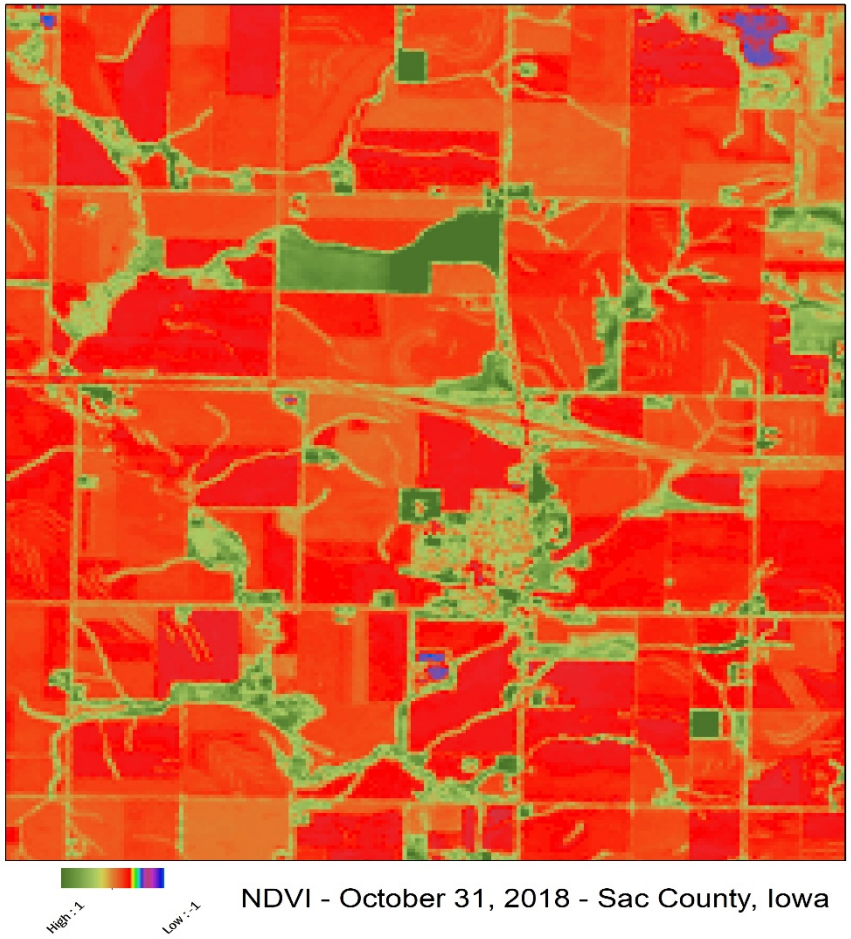


Normalized Difference Vegetation Index (NDVI)

Previous research suggests…

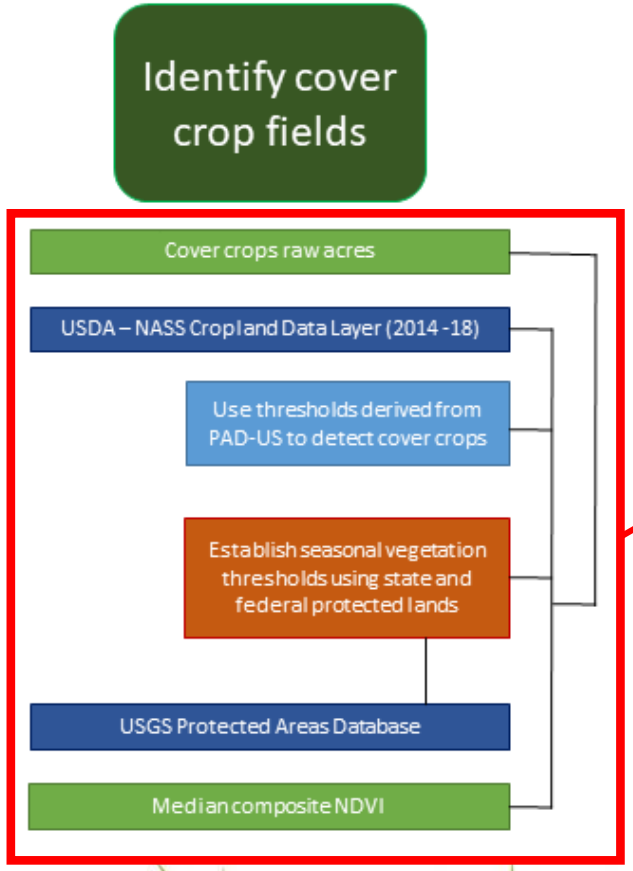
- Using Landsat 8, vegetation can be captured using moderate (0.2-05) to high (0.6-0.9) NDVI thresholds, when discriminating against non-vegetation and water (Taufik, et al, 2016).

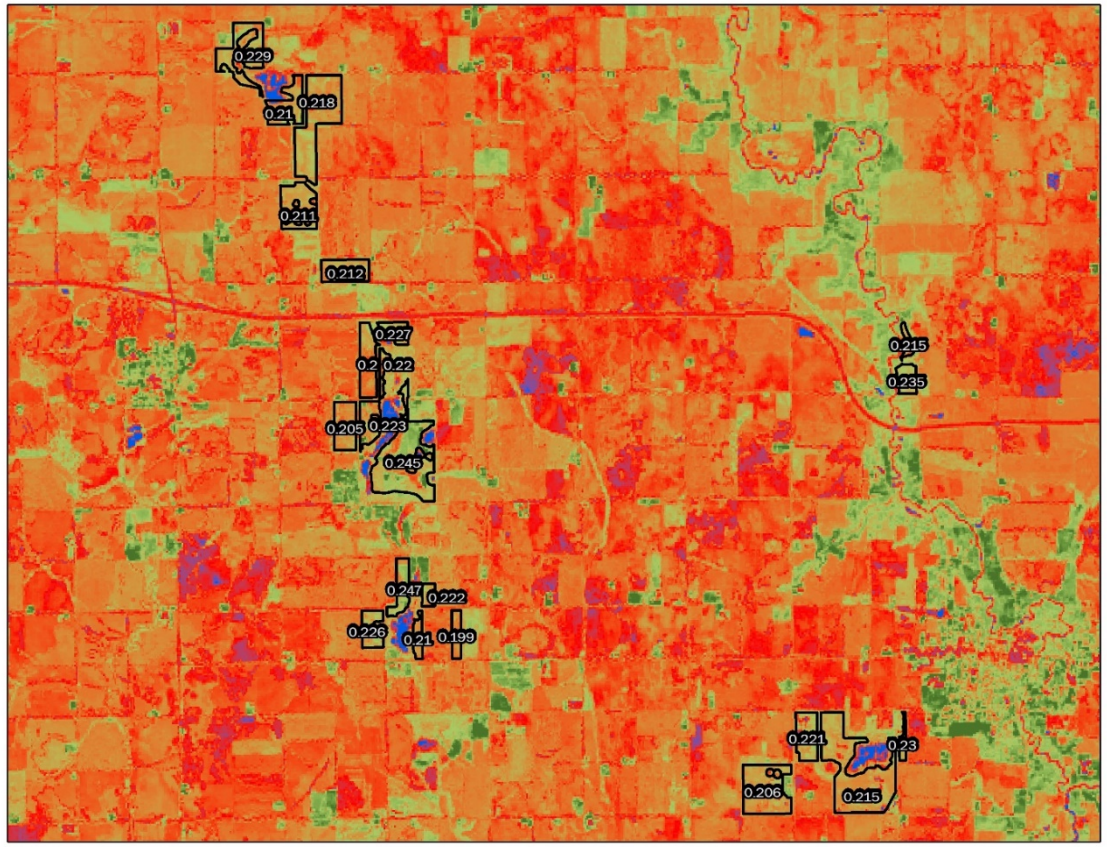
- Using Landsat 7, vegetative groundcover classes were established at minimal < low 0.29 NDVI” (Hively, 2016).



NDVI - October 31, 2018 - Sac County, Iowa

Establishing seasonal vegetation thresholds



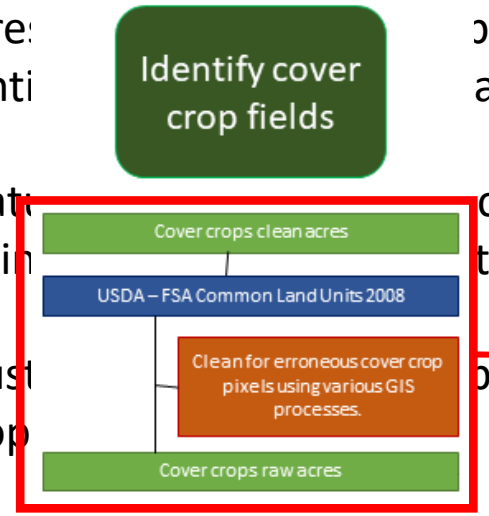


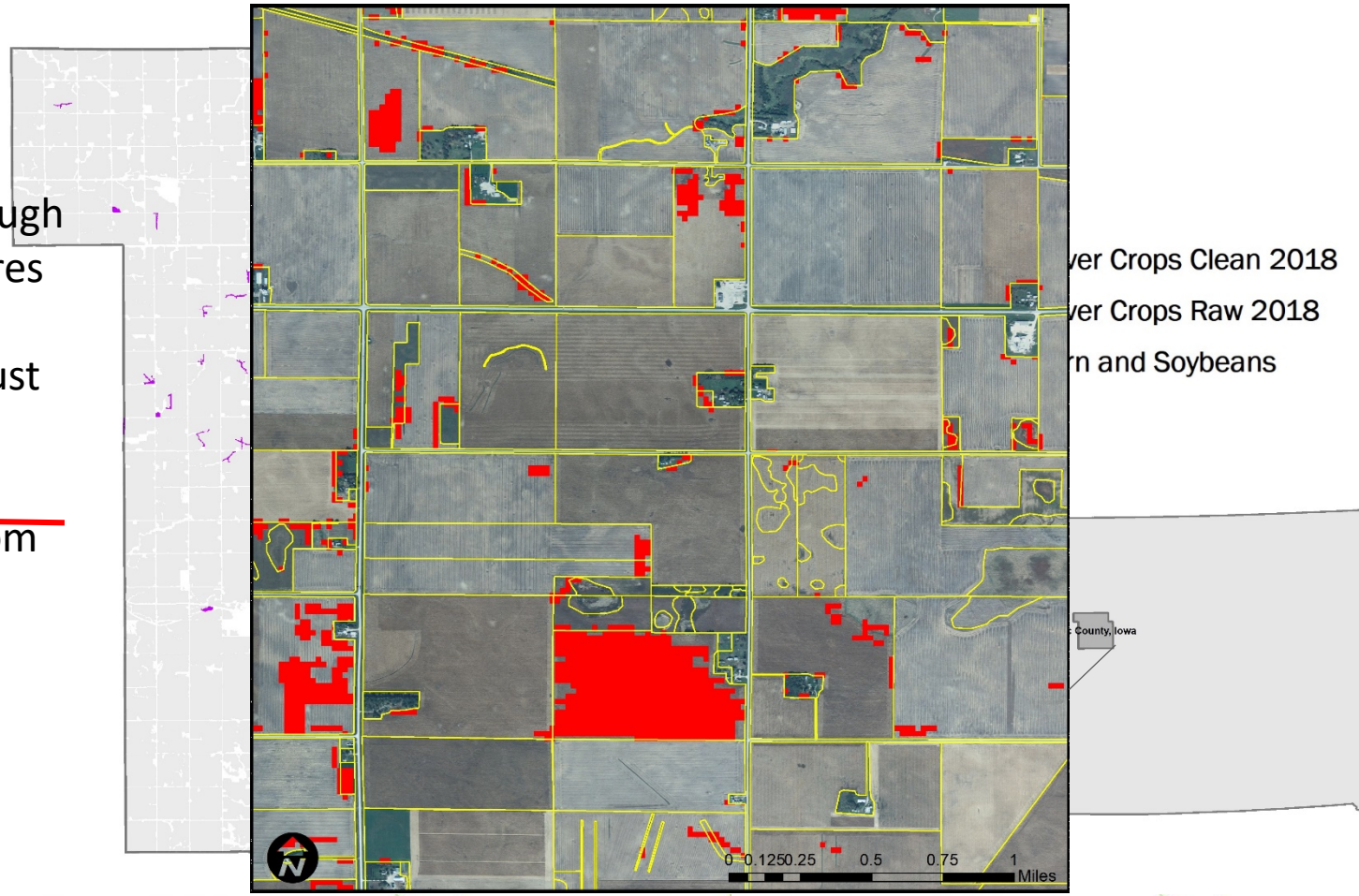
April-March 2018 (Spring) Cloud Free Composite

Cleaning data for erroneous pixels

Scrub the data…

- Acre pass through conti an 10 acres
- Feat crops must main teristics
- Mus beans from Crop
- Filter with Common Land Units





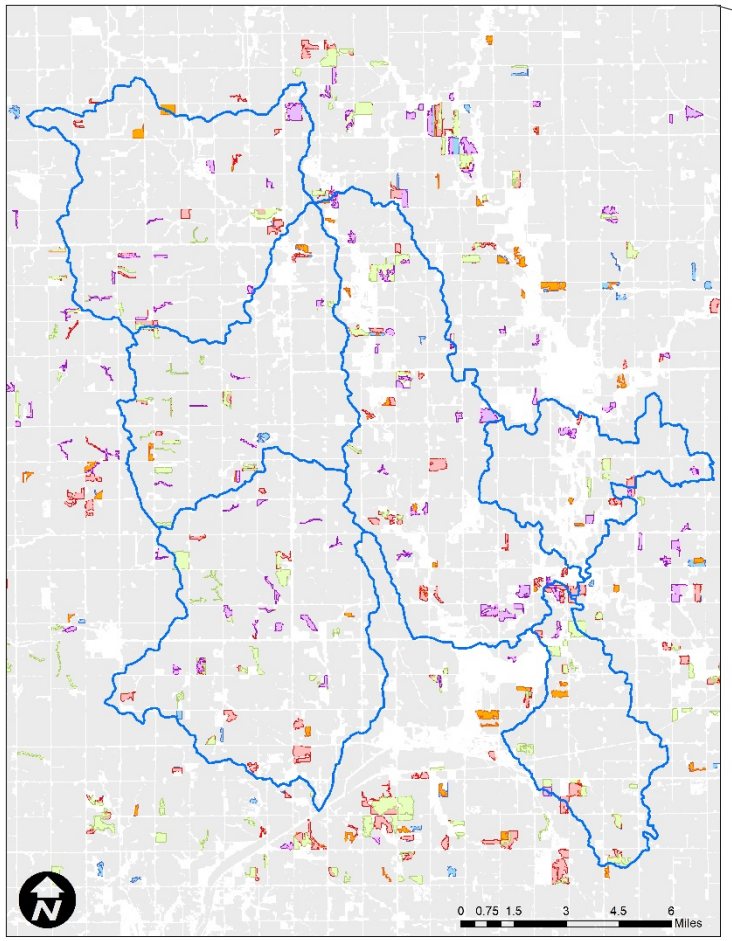
Correlation with other cover crop data

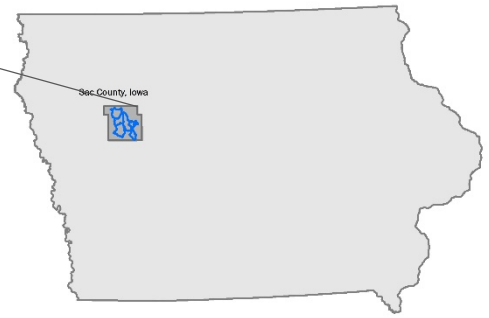
Validate findings

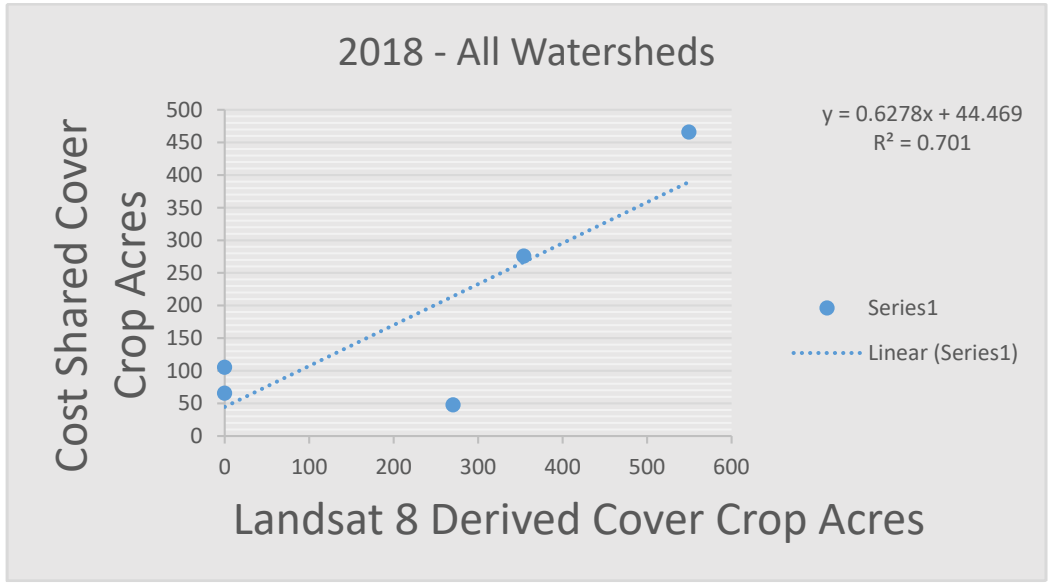
Compare results with government data to see if a strong relationship exists

Cover crops final

Watersheds within AOI
Corn and Soybeans
Cover Crops 2018
Cover Crops 2017
Cover Crops 2016
Cover Crops 2015
Cover Crops 2014



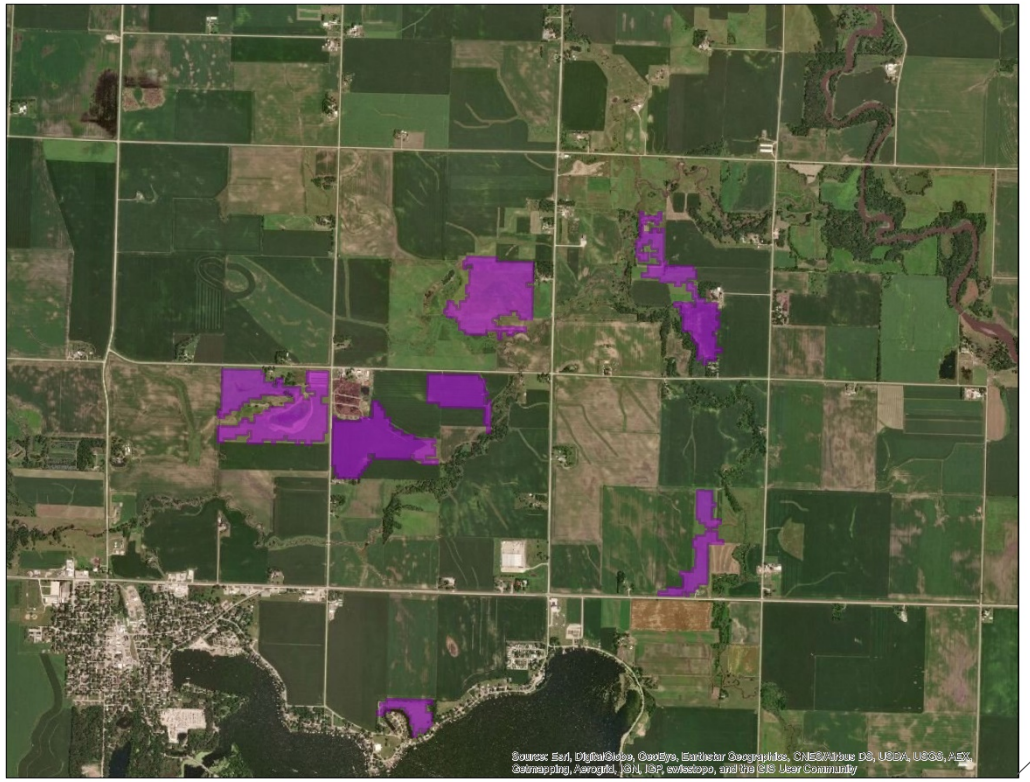




Layers for measuring effectiveness

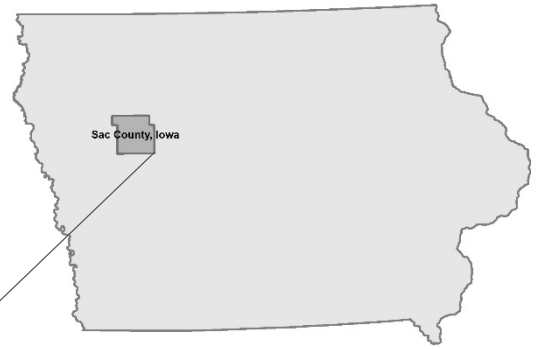
Interpret results

- Measure cover crop effectiveness
  - Cover crop areas crossed with vulnerable layer 1
  - Cover crop areas crossed with vulnerable layer 2
  - Cover crop areas crossed with vulnerable layer 3
  - Cover crop areas crossed with corn frequency



Legend

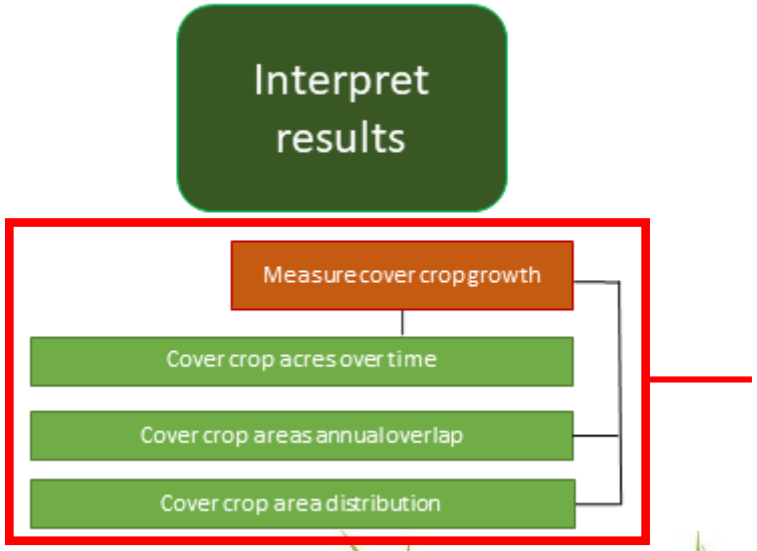
- Cover Crops 2018
- 100 Year Flood Plain (FEMA)

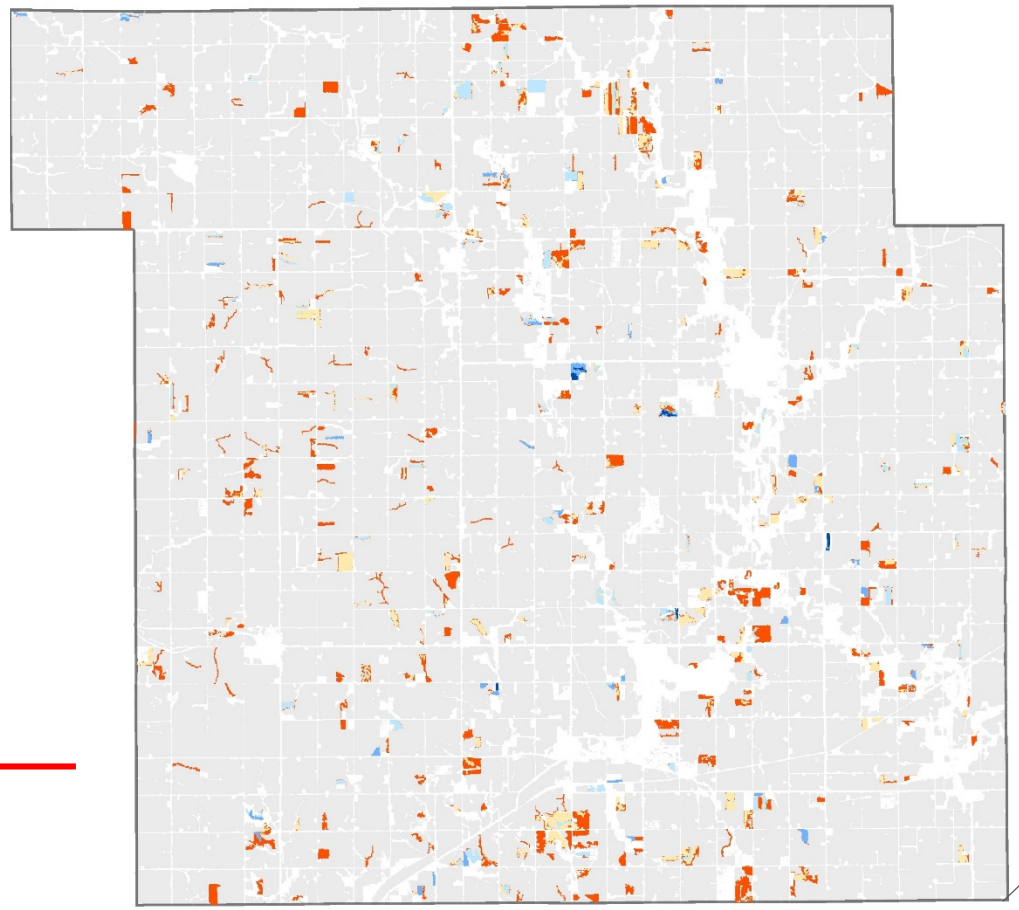


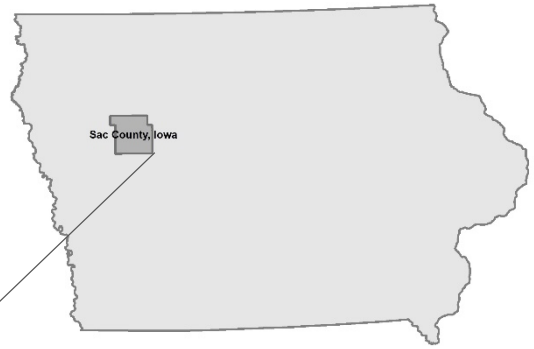
Cover crop growth

Measure cover crop growth…

- Spatial distribution of cover crop areas
- Frequency of cover crops
- Temporal growth







Expected results

Ideally, I'd like to see this practice growing on the landscape in areas that need it the most…

- Cost share accountability - Landsat derived acres having temporal alignment with cost shared acres.
- Investment is helping adoption - Cover crop growth outside of cost shared acre universe.
- Planting in areas that need the most help - Cover crops planted in most effective areas.

Continuing research

Leverage the framework to further study…

- Water quality - Can we quantify cover crop impacts through monitoring data.
- Weather impacts - Cover crop effectiveness in colder wetter regions.
- Deploy framework with Sentinel 2 – Available on GEE, sensor revisit more frequent and a higher resolution, catalog not as deep as Landsat.

Project Timeline

Tasks	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20
Write proposal								
Finalize proposal								
Run cover crop identification analysis								
Finalize literature review								
Clean and validate the results								
Interpret and review the findings								
Compile and summarize the findings								
Develop a manuscript								
Review period								
Journal submission								
Find validators								
Approach journal for submission protocol								

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