Using satellite imagery to determine crop residue cover for improving erosion estimates on agricultural lands

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- Aaron Ruesch
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Overview

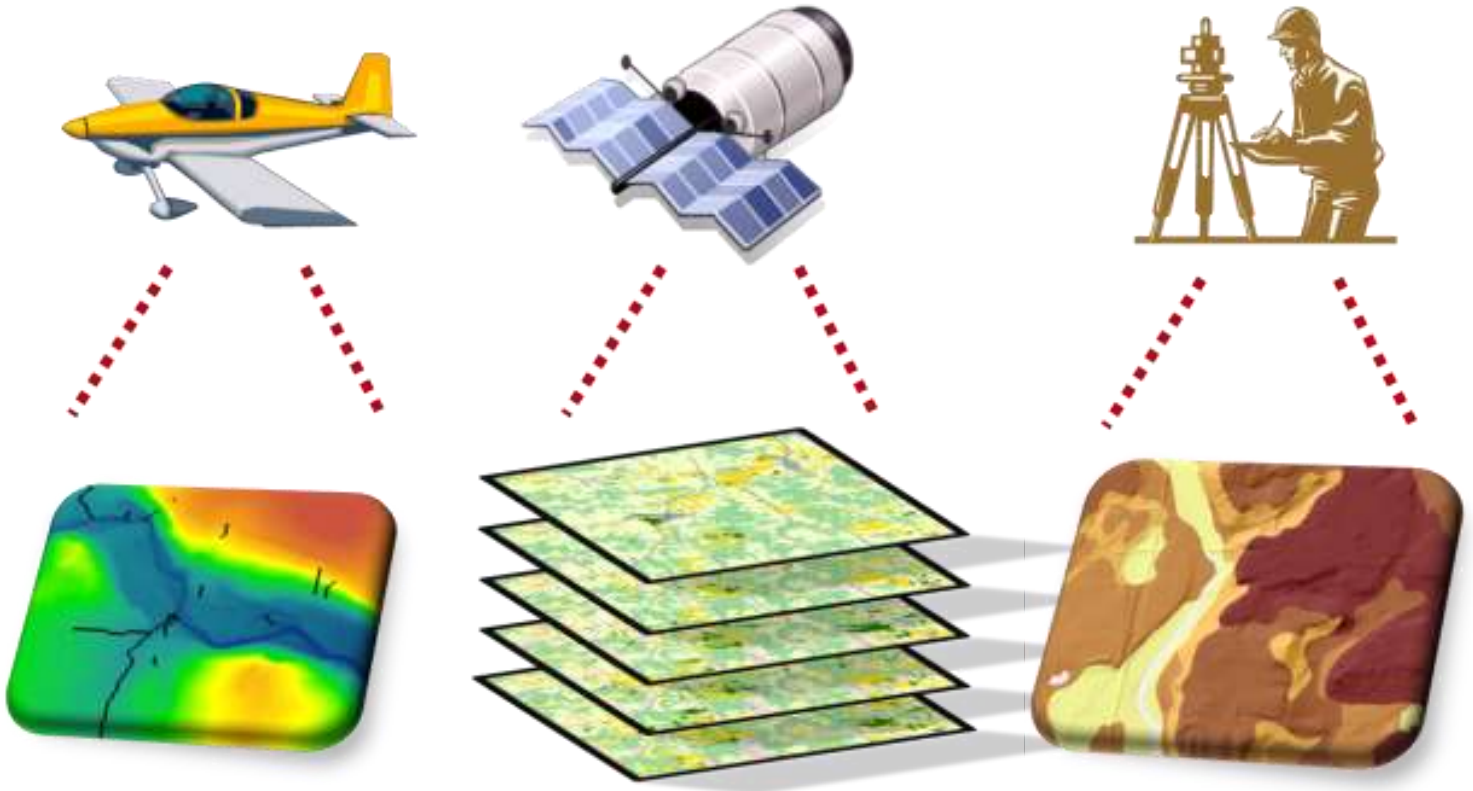
- EVAAL
- IDEP
- NDTI
- Clark County Data Analysis
- Pleasant Valley EVAAL Analysis

EVAAL

- **E**rosion **V**ulnerability **A**ssessment for **A**gricultural **L**ands
- GIS-based model
- Vulnerability to erosion and nutrient export
- Deprioritizes internally draining areas

EVAAL
Erosion Vulnerability Assessment for Agricultural Lands

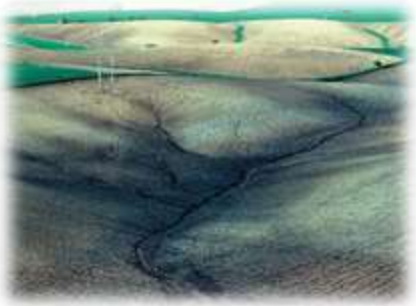
Available Datasets



LiDAR **Crop Data** **Soils**

Erosion Vulnerability Analysis

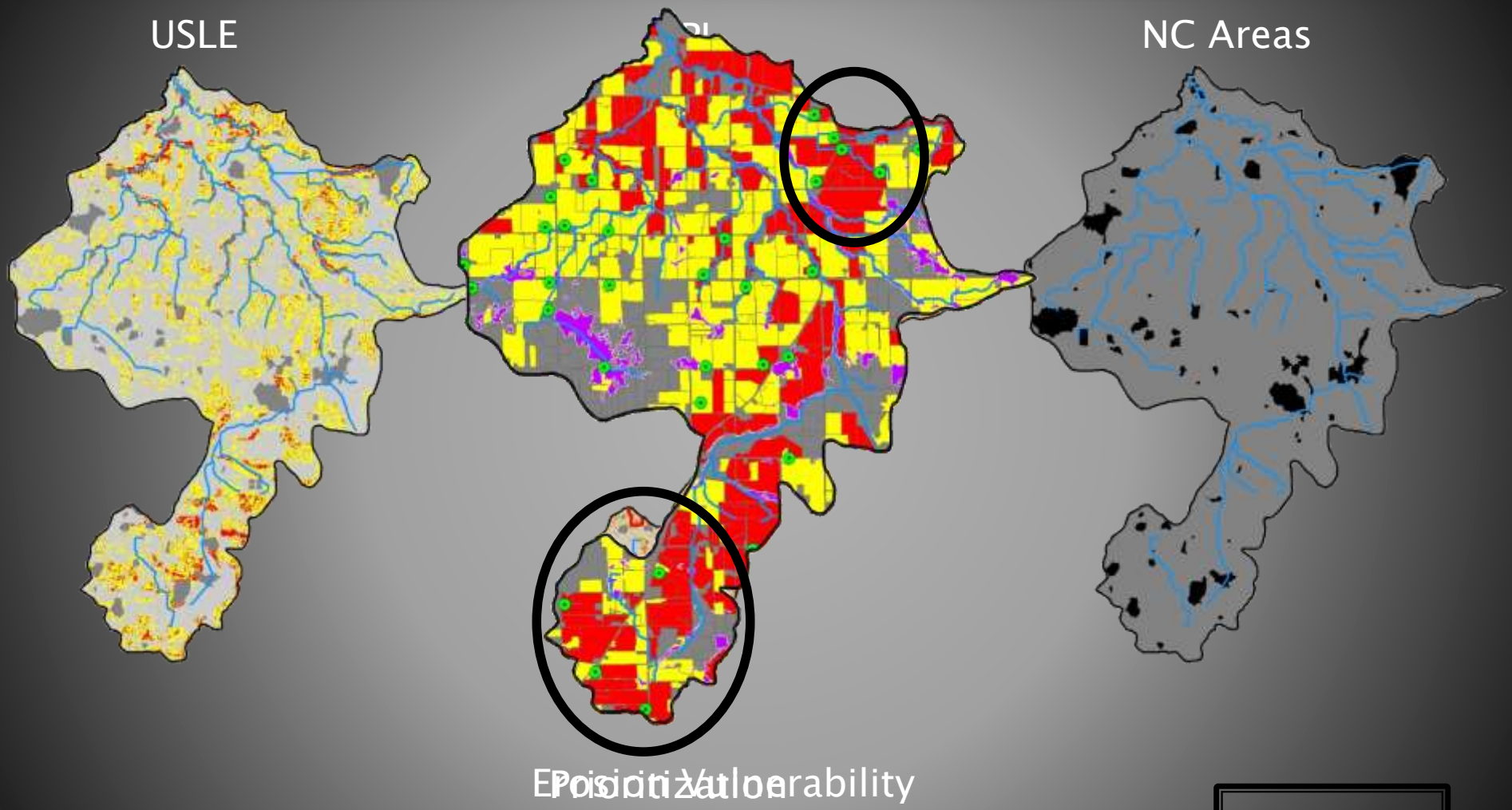
USLE + SPI – IDA



= EVAAL

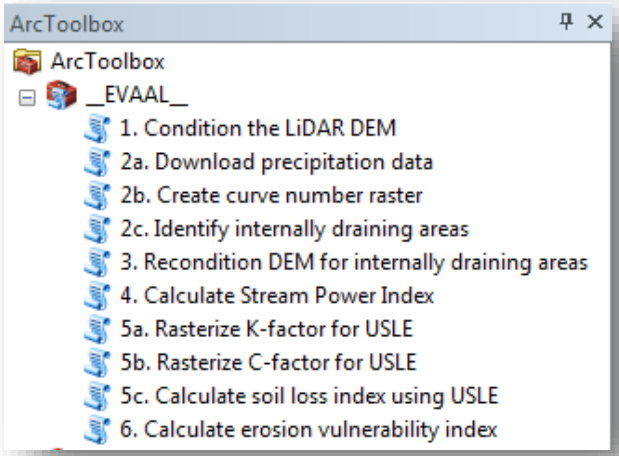
Erosion Vulnerability Assessment for Agricultural Lands

Results



EVAAL Website

- Documents
- Tutorial Data
- ArcToolbox



http://dnr.wi.gov/topic/nonpoint/evaal.html

Limitations

- We can't model what we don't know
  - Tillage
  - Manure application
  - BMPs
- Erosion must be driving factor
- Does not account for delivery factors or tile drainage
- Cannot "target", rather "prioritize"

USLE – Tillage Assumptions

$$A = RK(LS)CP$$

Cropland data layer

Crop Rotations

SNAP-Plus (RUSLE2) -> Rotational C Factor

Poor Good

USLE

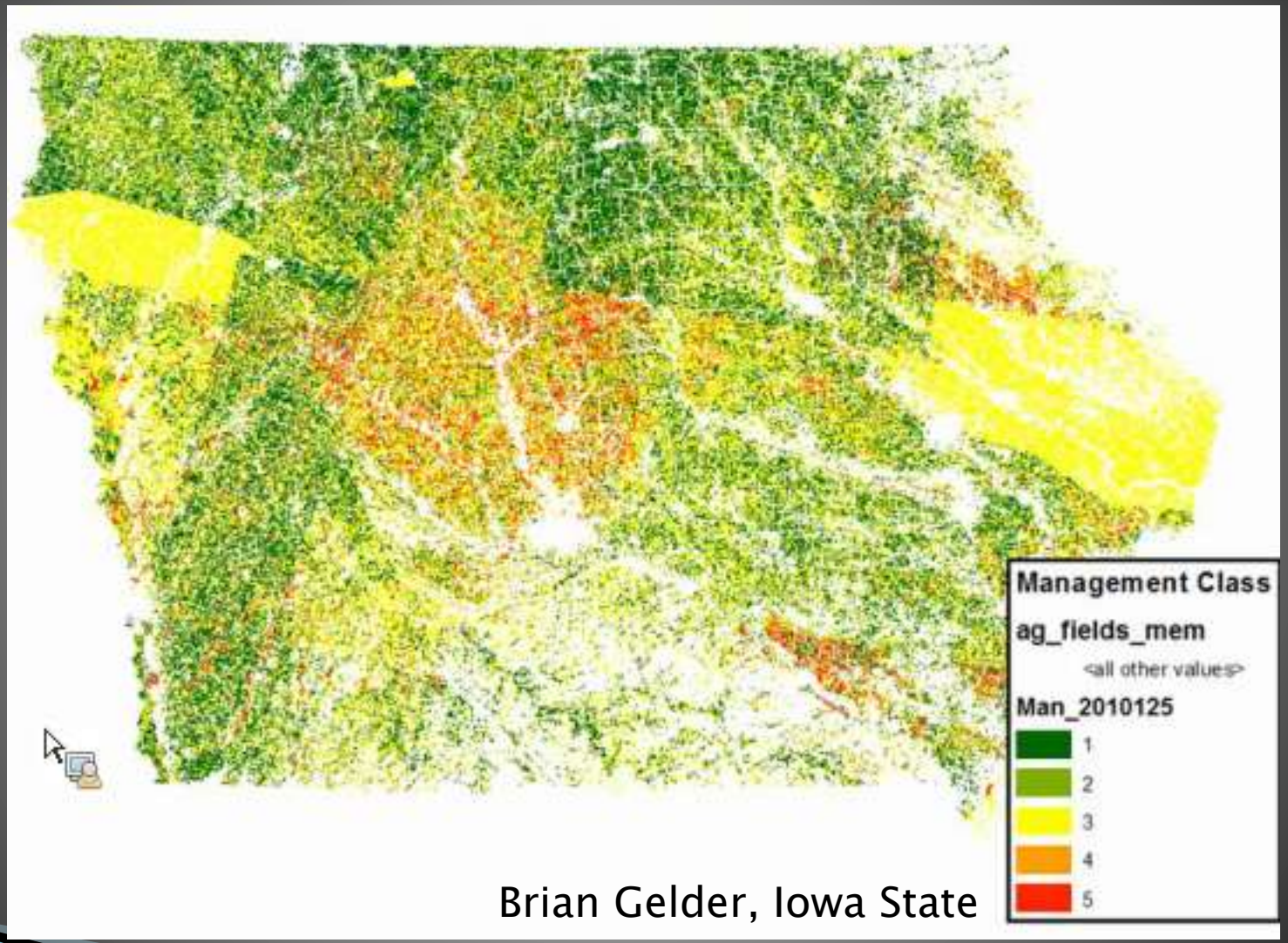
USLE w/ Low C Factor

USLE w/ High C Factor

Iowa Daily Erosion Project

- Daily estimates of rainfall, runoff, and soil erosion for the state of Iowa
- Collaboration:
  - Iowa State University, National Soil Erosion Research Lab, National Laboratory for Agriculture and the Environment, and The University of Iowa
- Updating to use remotely sensed information:
  - Crop rotations
  - Tillage
  - Topography

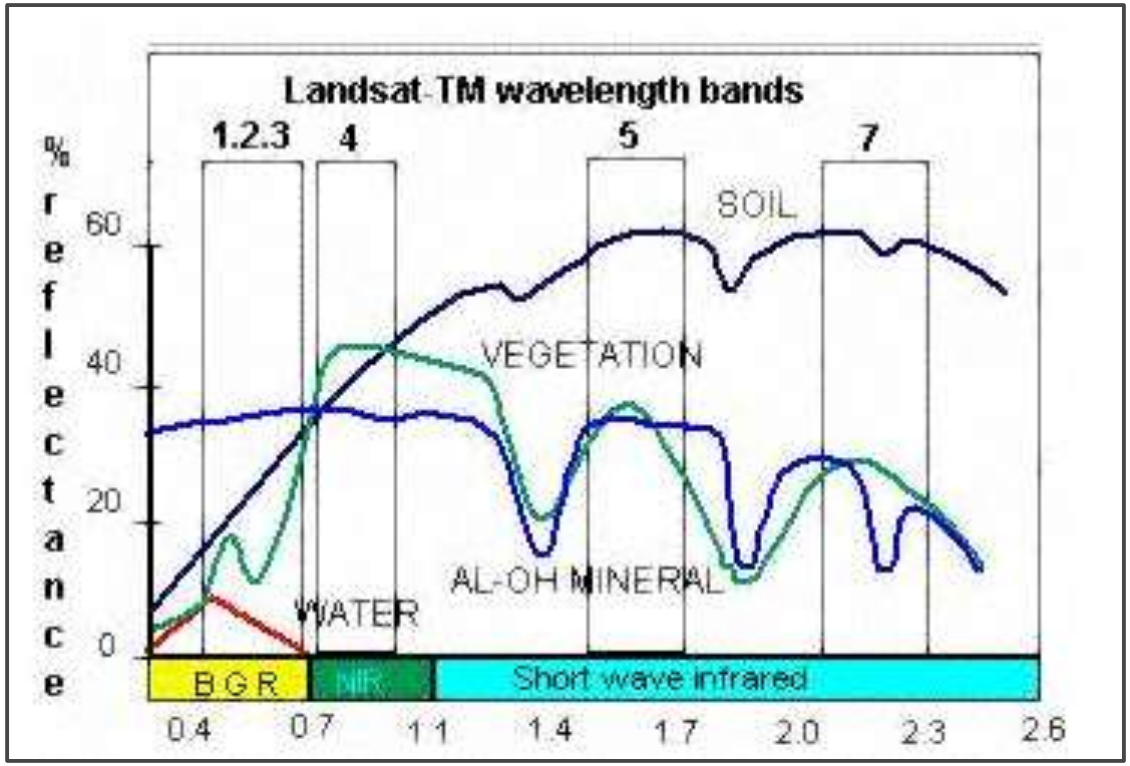
IDEP Example



Brian Gelder, Iowa State

Satellite Imagery Analysis

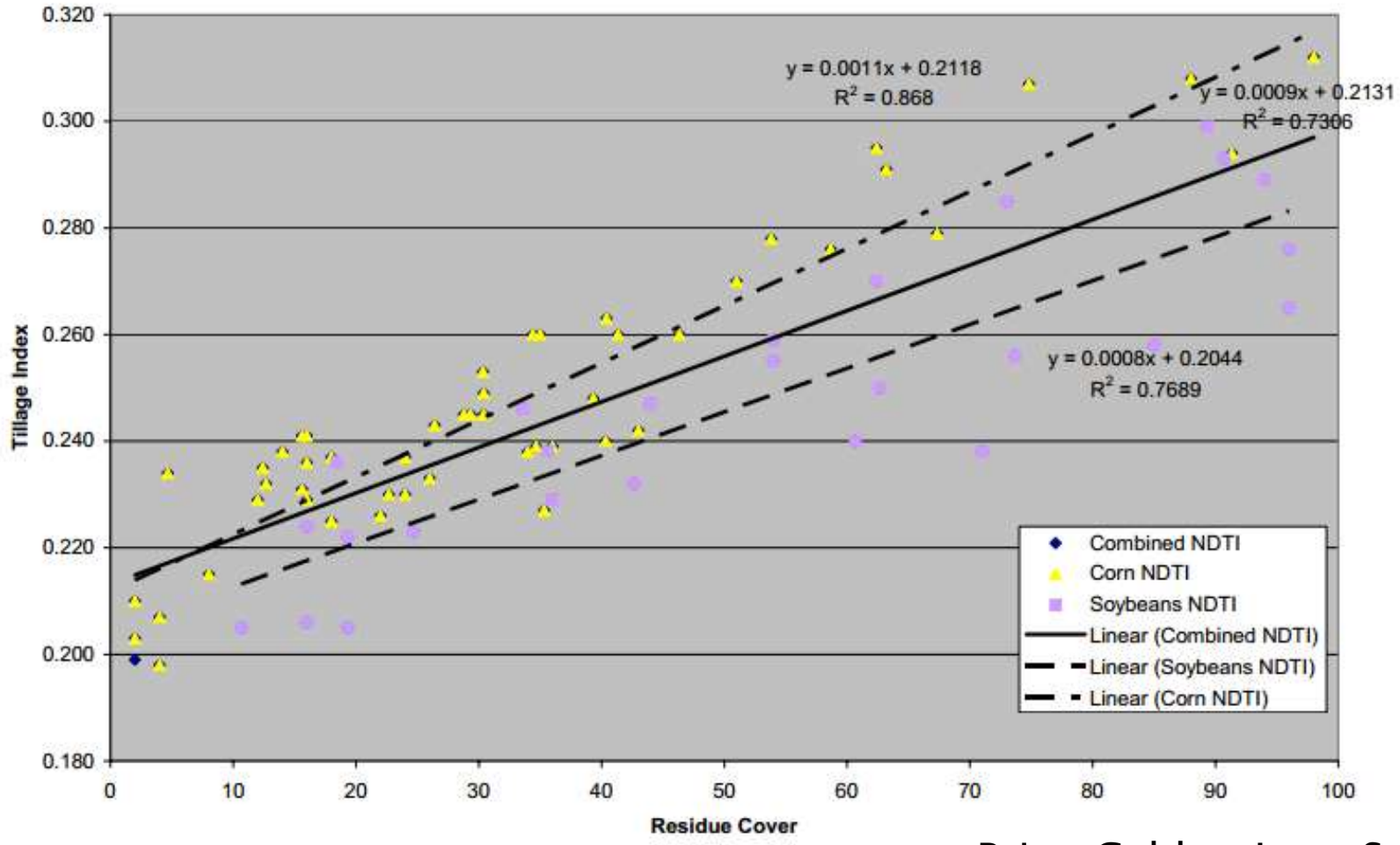
- Landsat 7 ETM+
- Normalized Difference Tillage Index
- NDTI = (band5 – band7) / (band5 + band7)



"Remote Sensing Of Crop Residue Cover Using Multi-temporal Landsat Imagery"
B. Zheng – 2012

NDTI and Crop Residue Cover

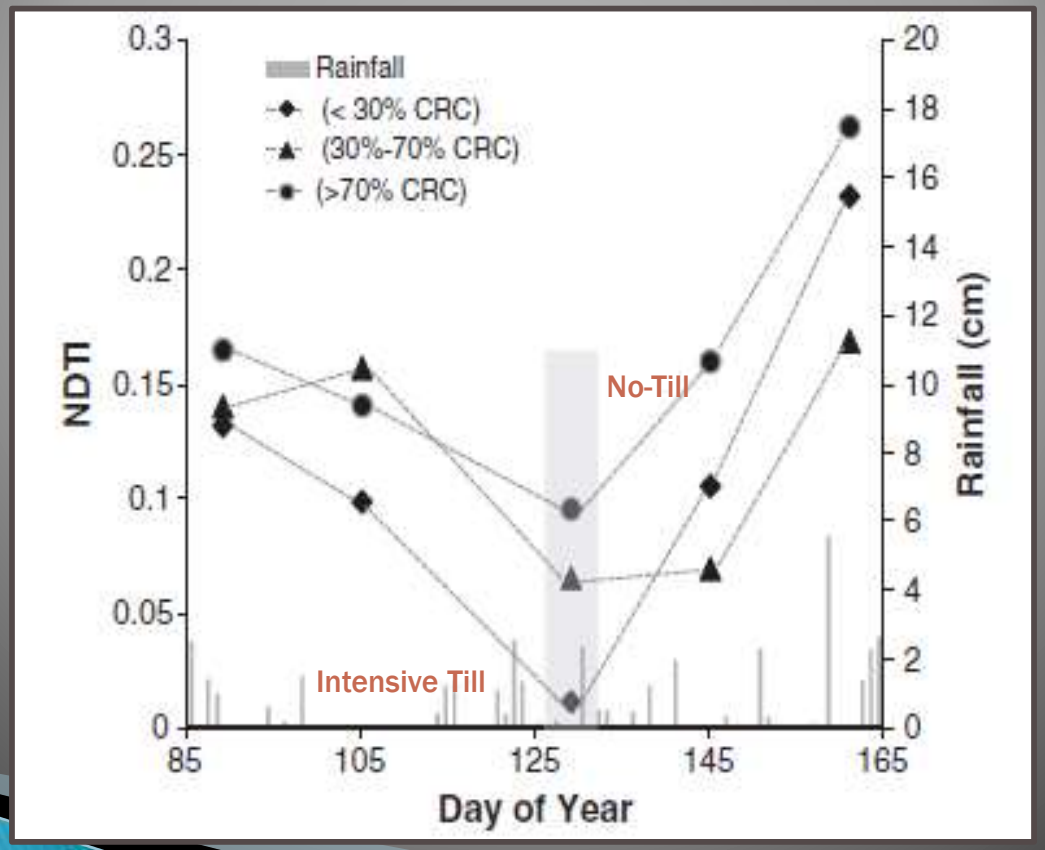
- NDTI is positively correlated with crop residue cover and green vegetation



Brian Gelder, Iowa State

minNDTI

- Tillage timing can vary greatly
- Field will have lowest NDTI value right after tillage/planting and before plant emergence



"Remote Sensing Of Crop Residue Cover Using Multi-temporal Landsat Imagery"
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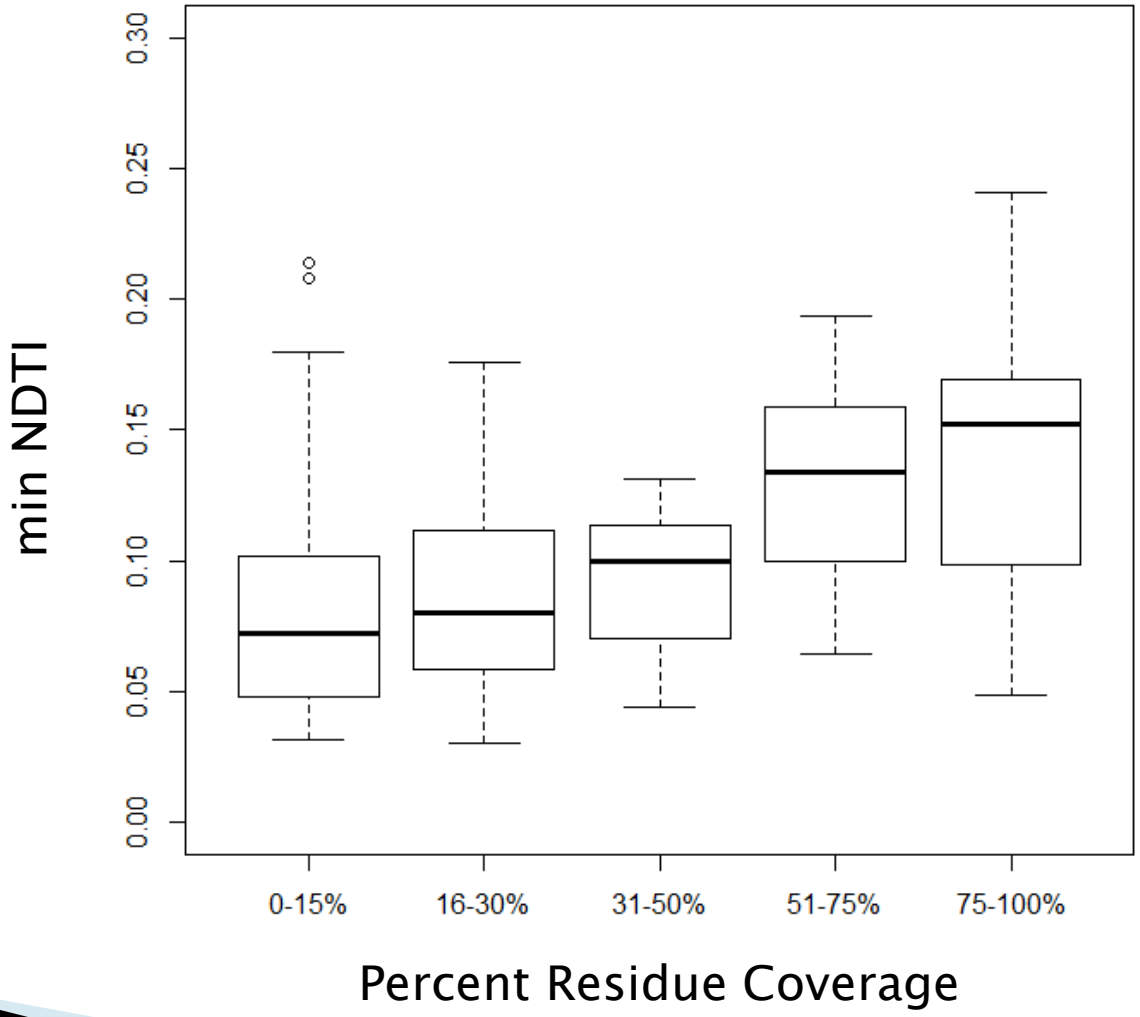
Clark County Transect Data

- Annual data collection
- Includes
  - Crop type
  - Tillage type
  - Percent residue

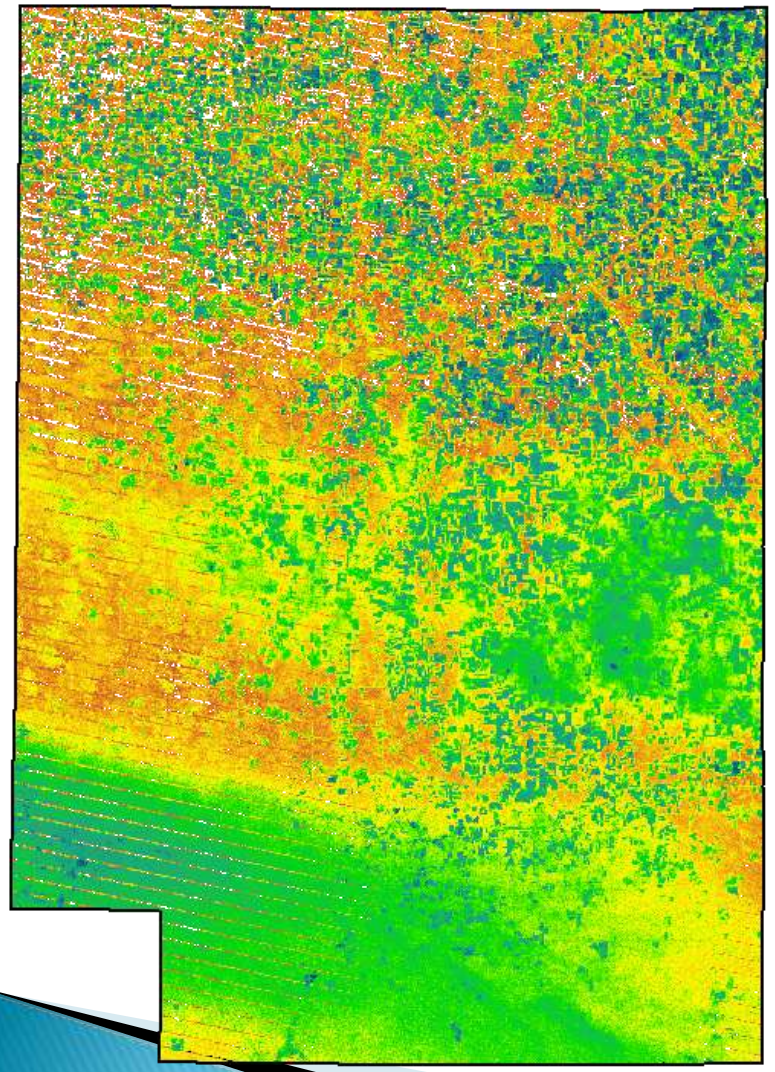
NDTI – CRC Analysis

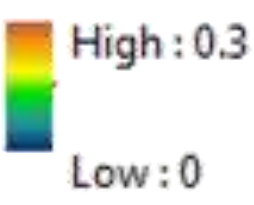
- Landsat 7 ETM+ (surface reflectance)
- Scenes from 2011
  - March–August
- minNDTI
  - May 16
  - June 1
  - June 17
  - July 3
- Averaged for each transect field

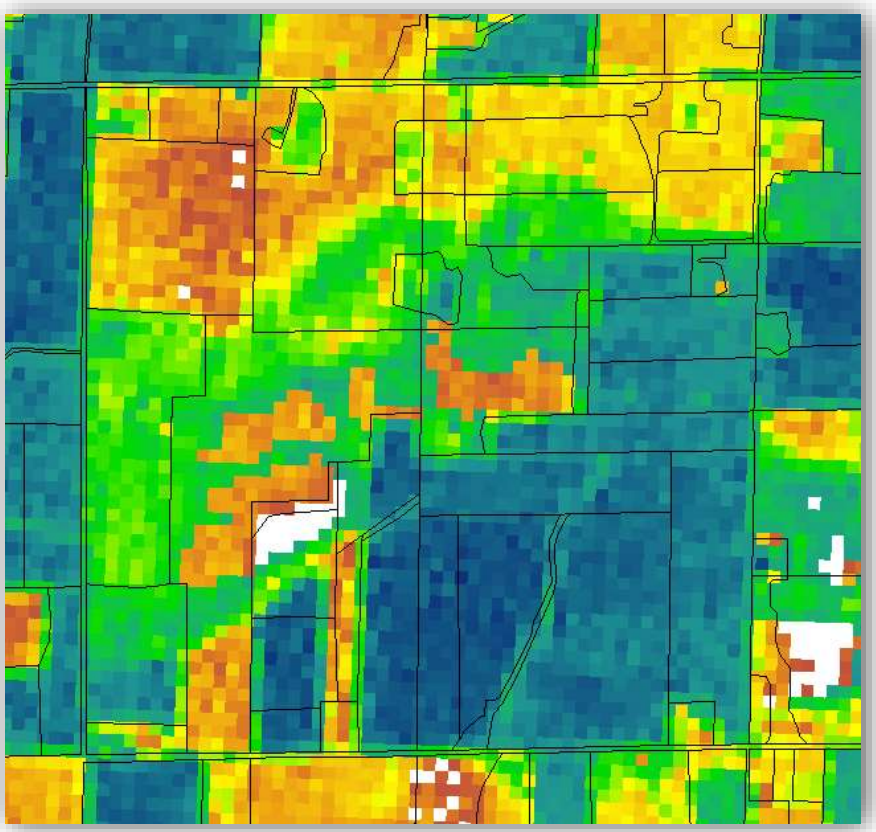
Clark County minNDTI



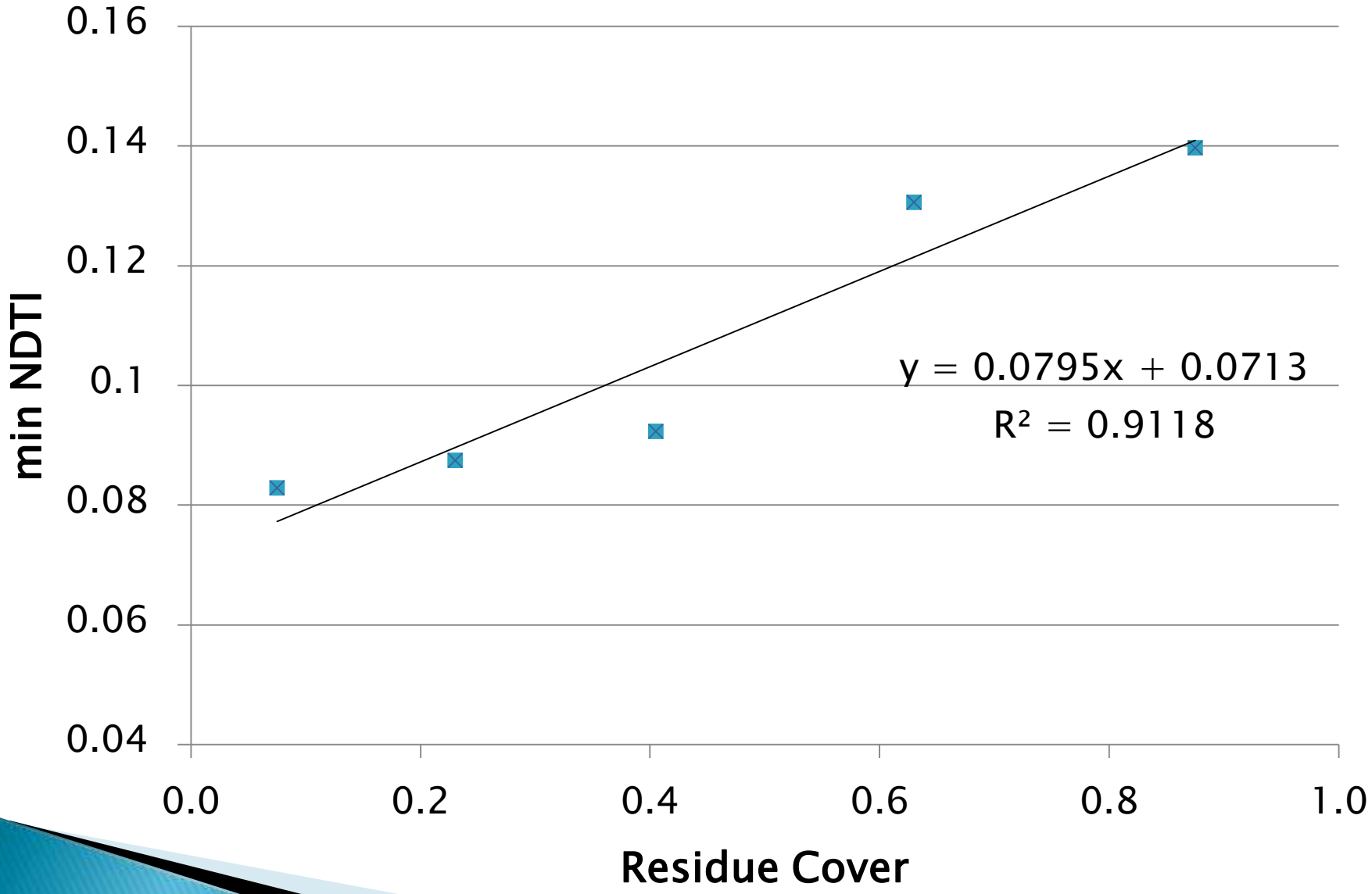
minNDTI







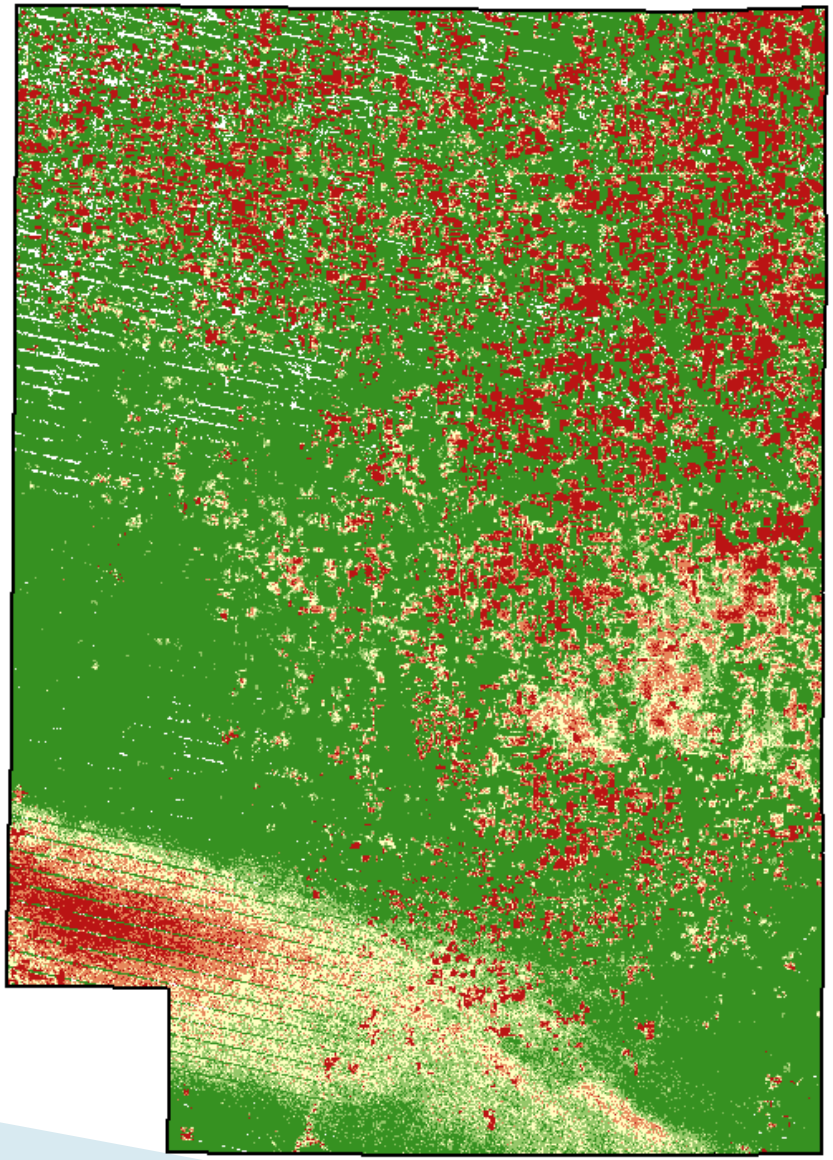
Clark County minNDTI



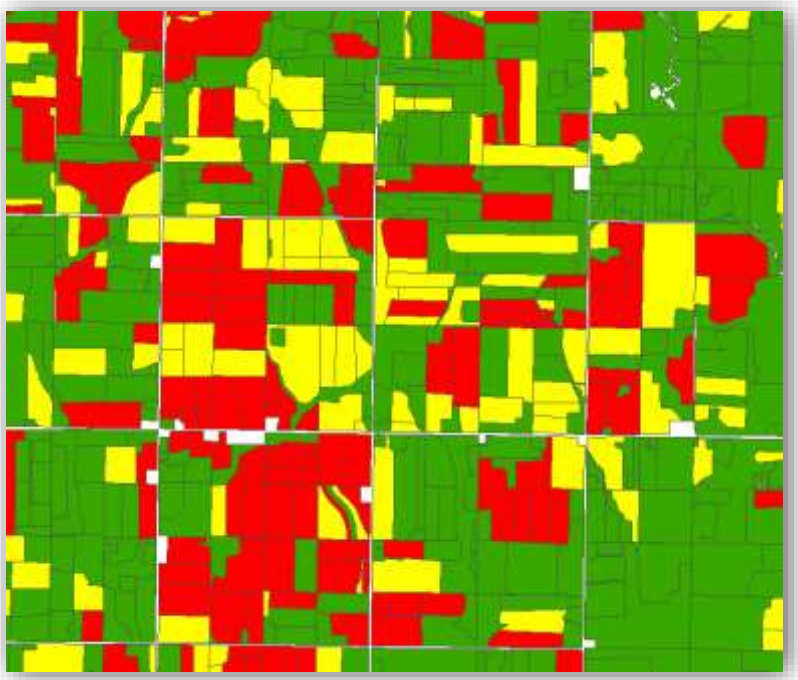
Crop Residue Cover

Crop Residue Cover %

- 0% - 20%
- 20% - 40%
- 40% - 60%
- 60% - 80%
- 80% - 100%

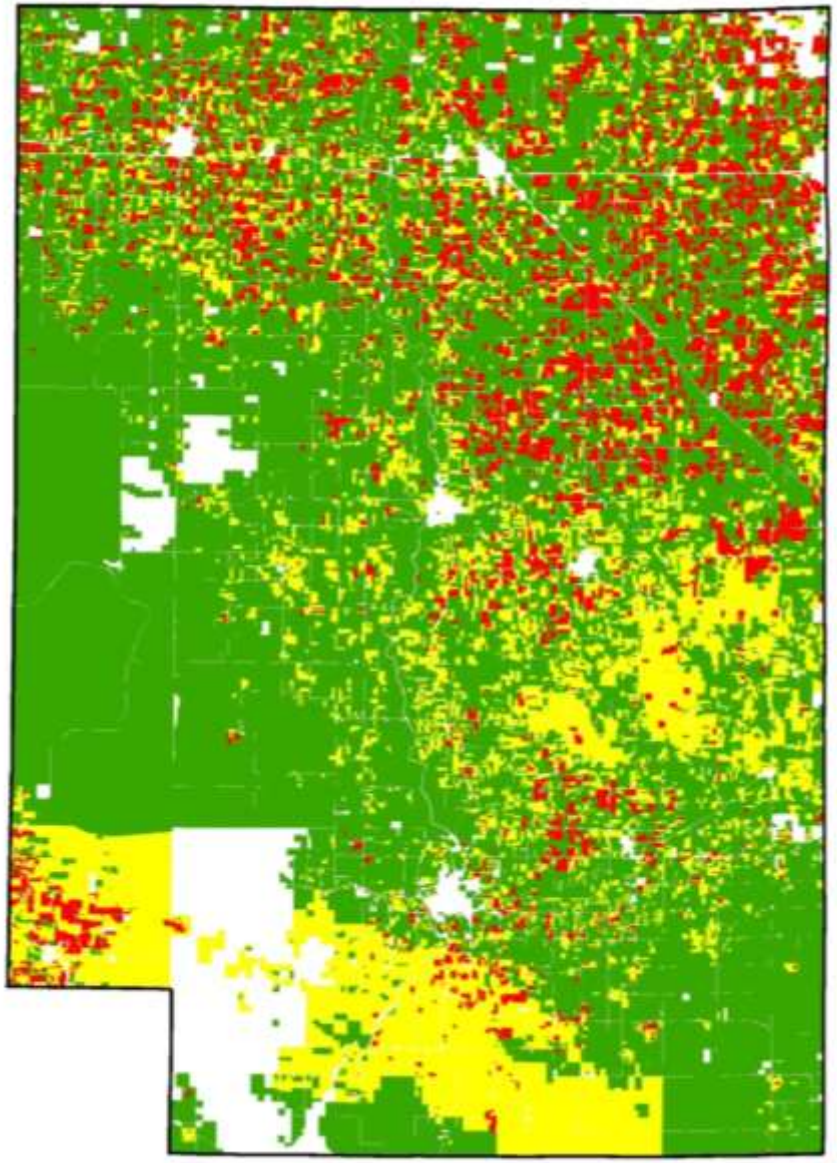


Relate to Tillage Types



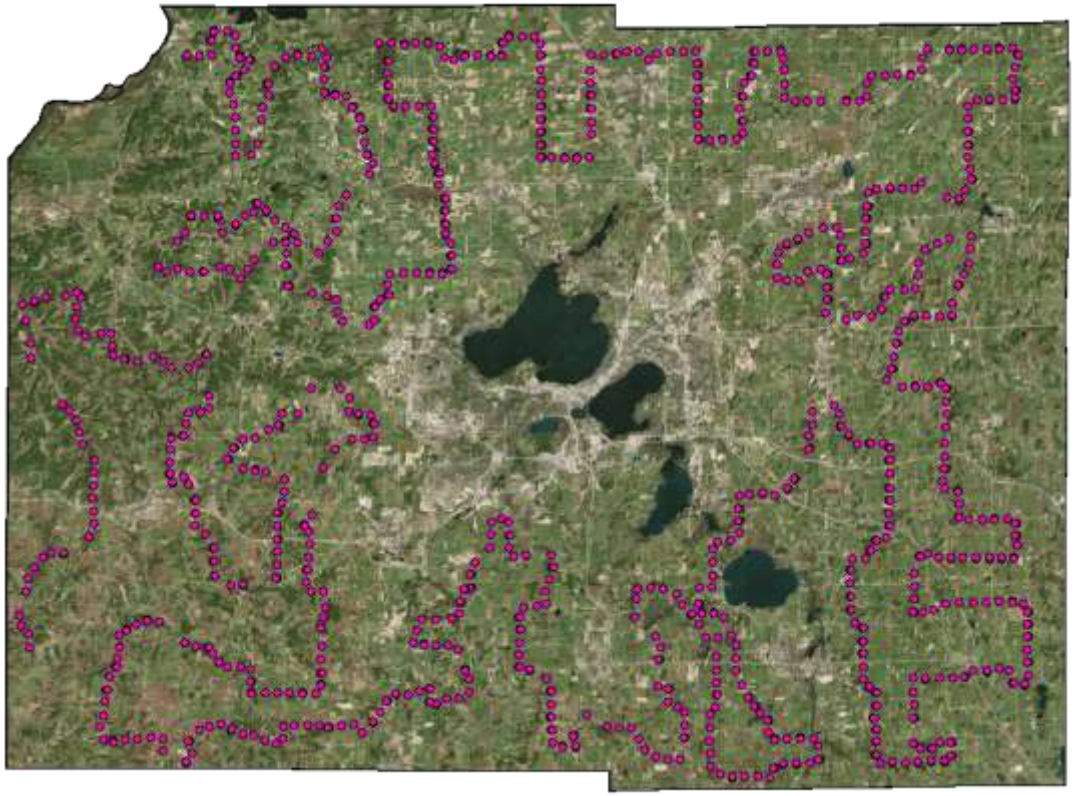
NDTI

Moldboard (0%–15%)	0.024337 - 0.083000
(15%–75%)	0.083001 - 0.131000
No Till (75%–100%)	0.131001 - 0.300000

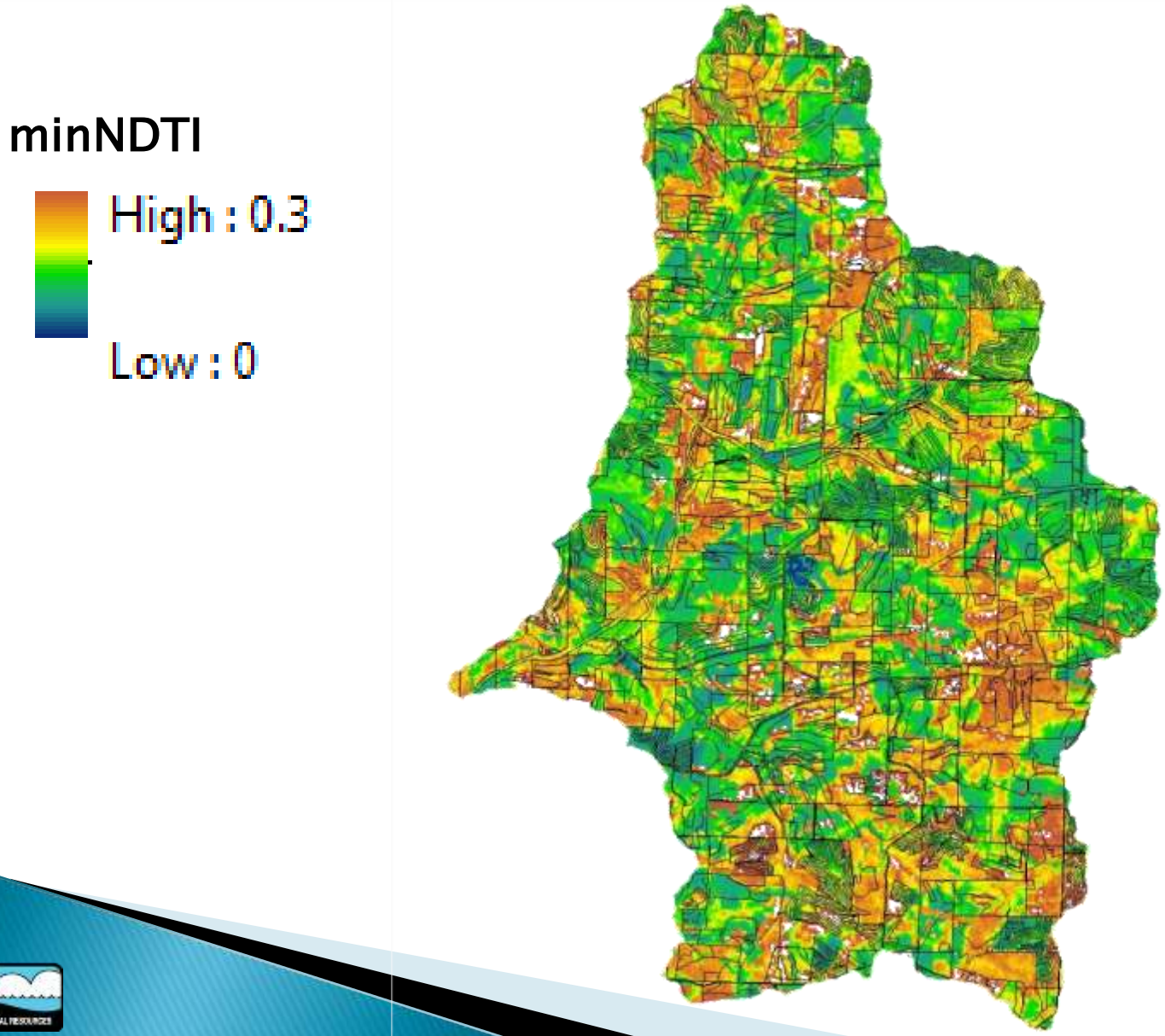


Pleasant Valley EVAAL

- Dane Co. transect data
  - Just tillage type – no % residue cover
- Analysis for Spring 2010



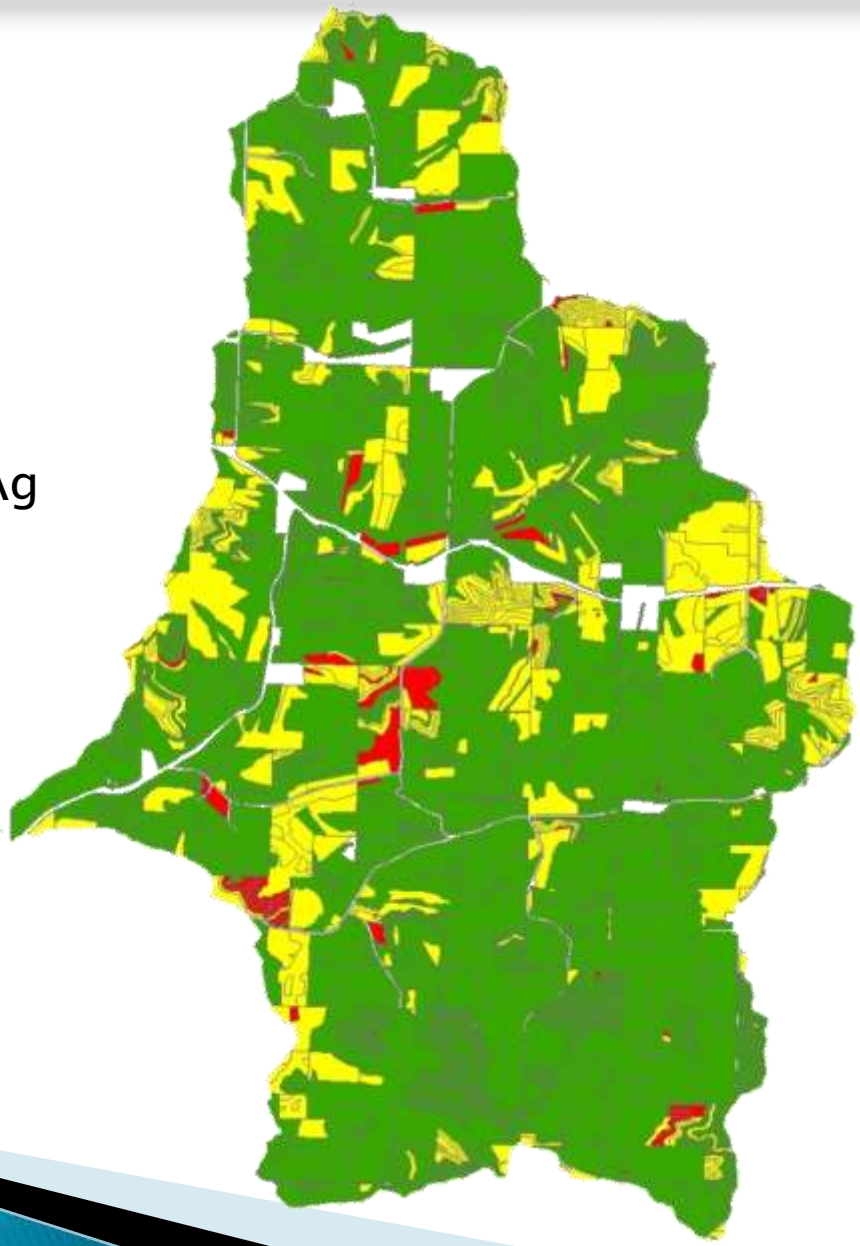
Pleasant Valley minNDTI



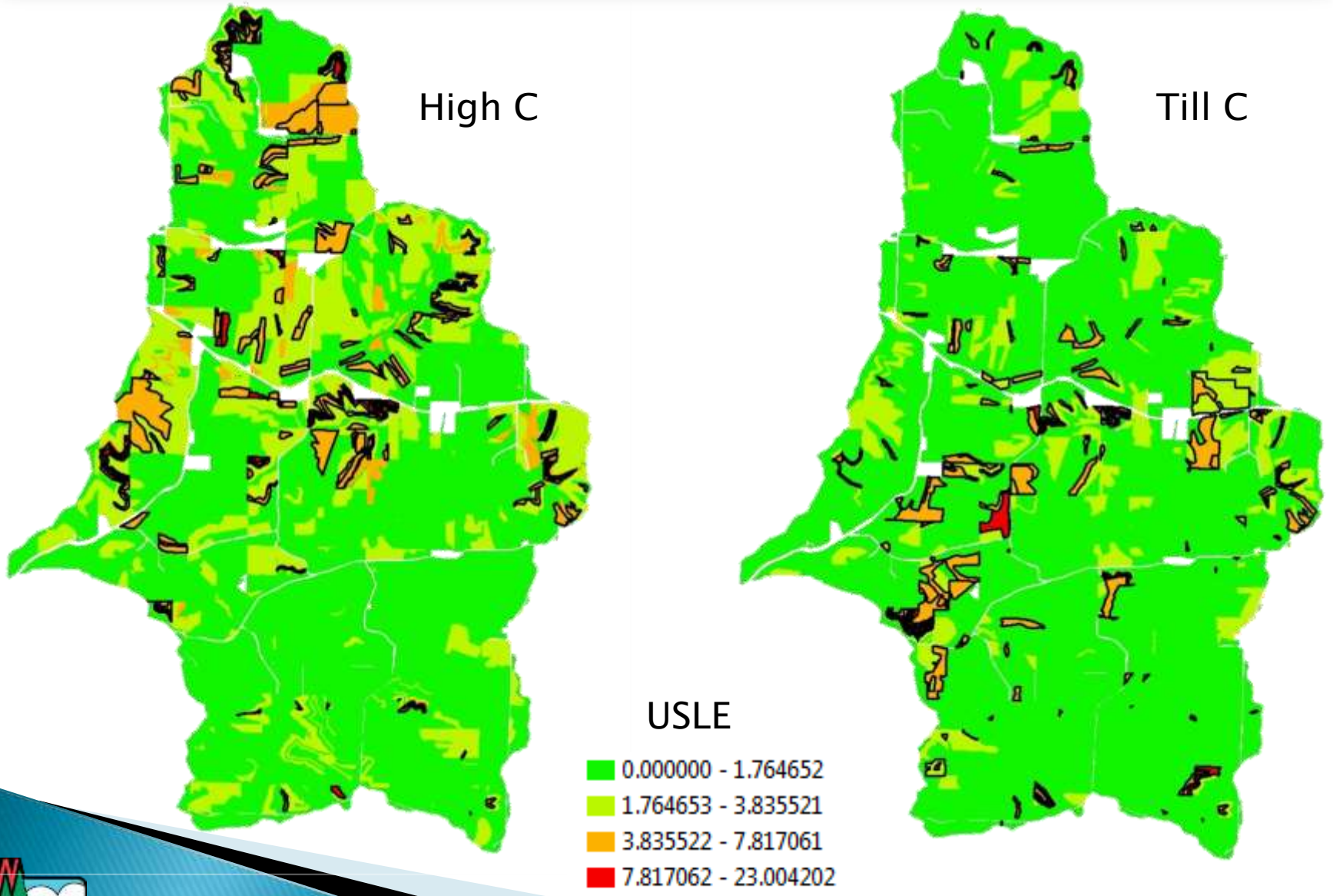
Pleasant Valley Tillage

Tillage Type

- Moldboard
-
- No-Till/Non-Ag



Pleasant Valley USLE



Challenges

- Landsat
  - Data gaps
  - Clouds
  - Timing/availability
- Validation data
- Computing time/power

Next Steps

- Evaluate automating process
- Determine tillage for multiple years
- Incorporate into EVAAL
- Potentially coordinate with Iowa State

Conclusions

- EVAAL assess erosion vulnerability; can be used to prioritize watershed efforts
- NDTI is positively correlated to crop residue coverage; can be used to infer tillage
- EVAAL results can be improved using satellite derived tillage information

Questions

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