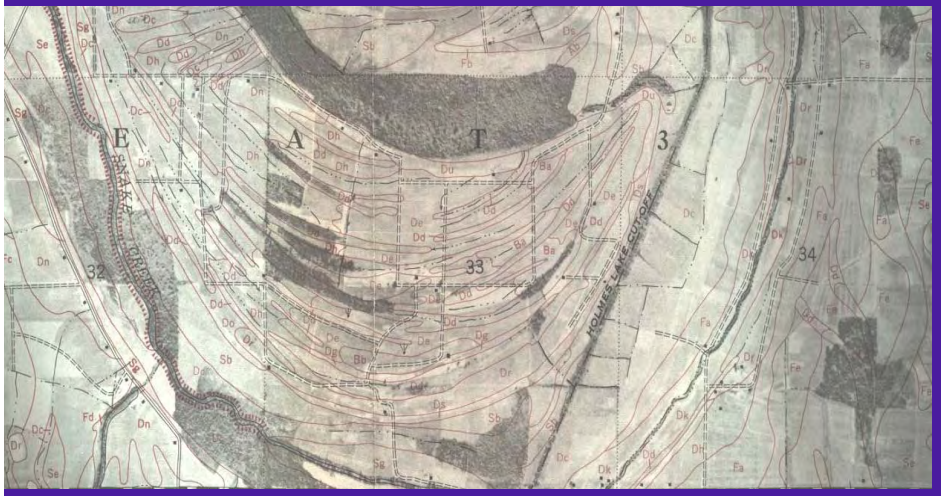
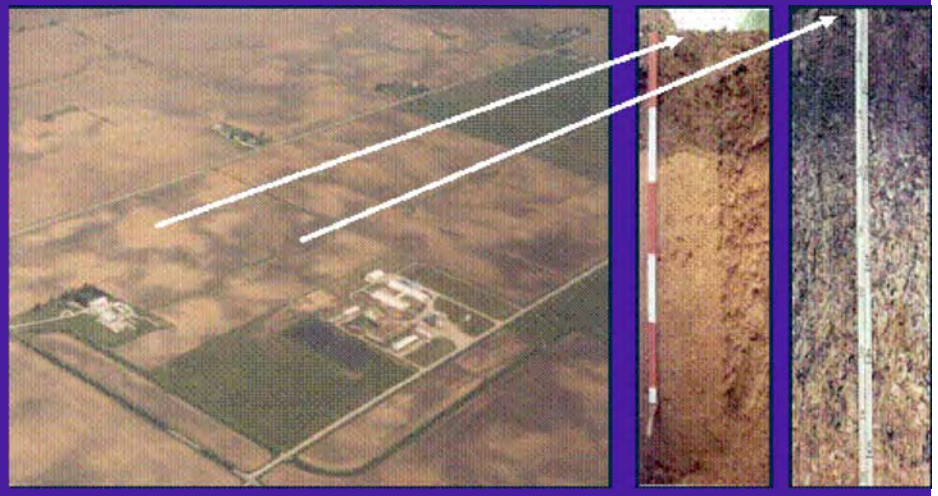
Yield Relationships with Soil Properties

Why do we care?

- Optimum yields
- Minimal soil degradation
- Increased long term productivity
- Efficient input use
- Lower environmental impact
- Best management practice development

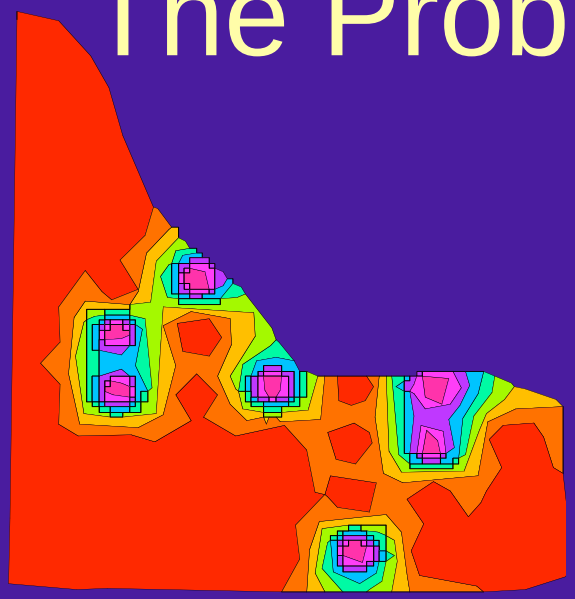
The Problem: Variability

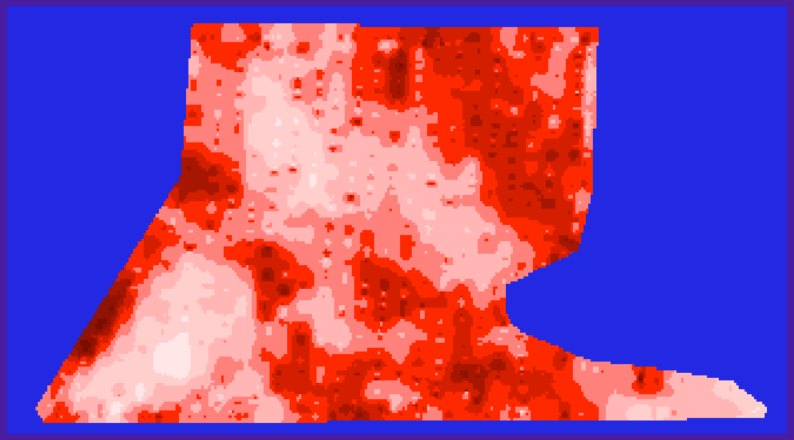




- Some is apparent
- Easily recognized in the field
  - Soil color (i.e. wetness, organic matter)
  - Soil texture (water retention, workability)

The Problem: Variability





- Some is not so apparent
  - Fertility
    - Phosphorus, Potassium, pH
  - Electrical Conductivity

Yield/Soil Relationships with Variability

- We need to understand how Yield/Soil relationships change across different areas of a field with time.
  - Allows site-specific soil management
    - Variable rate fertilizer
    - Variable rate lime
    - Variable tillage?
    - Variable planting rate or variety
    - Etc.

Methods

- Soil Sample Directed
  - Intensive soil sampling (1/4 – 2.5 Ac grid)
    - Fertility (P, K, Ca, Mg, pH, etc.)
    - Texture (% Sand, % Silt, % Clay)
  - Yield measurement at soil sample points
    - Yield monitor
    - Hand harvesting and weighing
  - Topography
    - Elevation
    - Slope
    - Curvature
    - Aspect
  - Other……..

Relationship site and year specific

- Soybean field 1
  - Year 1 = 3729 – 2.79 P – 4.95 Elev – 4.14 Slope + 3.42 Clay content.
  - Year 2 = 3197 + 2.83 CaMg – 4.46 P – 7.16 Elev – 2.16 Slope.
- Presence of P and Topography in both years

Relationship site and year specific

- Soybean field 2
  - Year 1 = 3789 + 2.94 pH – 3.15 Elev – 7.68 Slope.
  - Year 2 = 4035 + 3.49 pH – 3.36 Elev – 4.81 Slope.
- Note that soil and topography influences did not change

Within Field Issues

- Year 1: Soybean
  - Yield = 2491 – 1.37 (Clay content, Ca, Mg) – 1.79 (P, K) -1.57 Slope -1.36 Elev
- Year 2: Corn
  - Yield = 1410 + 3.42 Clay content – 2.59 (P, K) – 4.44 pH + 2.18 Slope – 6.55 Elev
- Generally same issues for both crops

What we've found: Variability

- Fertility had a range of variability
  - pH tended to be low
  - P tended to be high
  - K was somewhere in the middle
- Yield variability: moderate
- Texture variability: moderate
- Elevation had a range of variability
  - Field specific
    - leveled vs. natural
    - Delta vs. Hills

What we've found: Crops

- Directly manageable properties
  - Yield related to P and K and pH
    - Sometimes positive
    - Sometimes negative
      - Indicates some other property reduced yield
- Indirectly manageable properties
  - Yield positively related to clay and slope
  - Yield negatively related to elevation
  - Most likely related to crop available water
- Indications are that water availability limits yield

What we've found: Crops

- Variable rate application of P and K may be worthwhile
  - Low yielding, high P and K areas don't need more fertilizer
  - High yielding, low P and K areas need to be maintained
  - Management may change with climate changes

What we've found

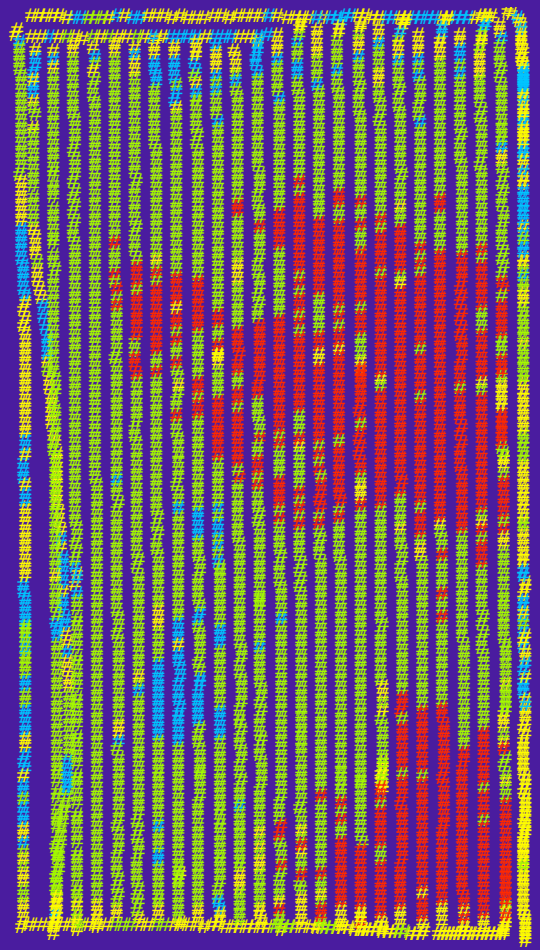
- Decision making with yearly data can be confusing
  - Changes in spatiotemporal variability can cause interpretation problems

Methods

- Yield Zone Directed (Removes temporal variability)
  - Identifying areas of a field that behave similarly over time.
  - “Whole field” yield measurement
    - Yield monitor data
    - Generally over multiple seasons
  - Identify “within field” zones
    - Consistently high yielding
    - Consistently average yielding
    - Consistently low yielding
    - Inconsistent
  - Sample from zones to determine relationships
    - Same measurements as in Method 1

What we've found

- Zones developed from four years of yield data
  - Consistently high
  - Consistently average
  - Consistently low
  - Inconsistent



Results field specific

- Soybean field 1
  - Sand content
  - K
  - pH
- Soybean field 2
  - pH
  - Clay Content

Results field specific

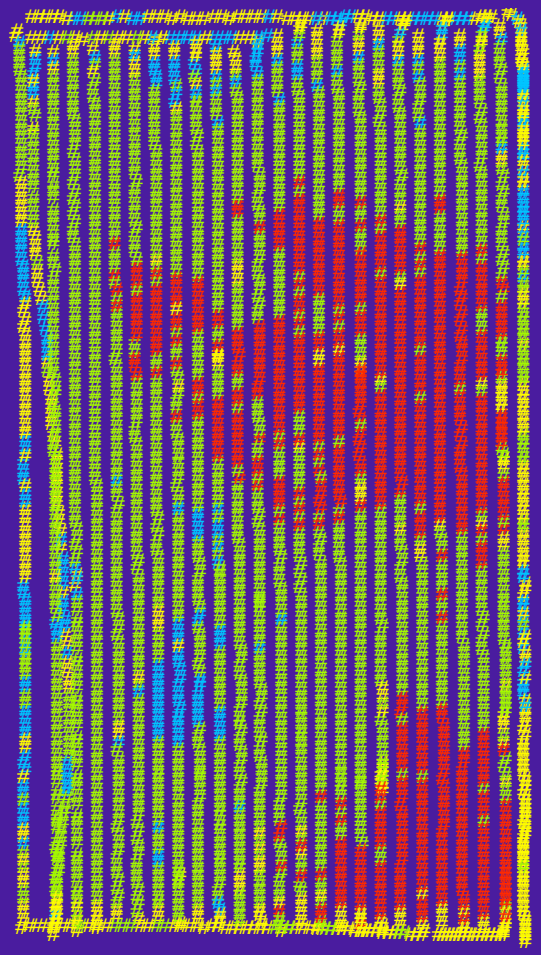
- Soybean field 3
  - Clay and Sand contents
  - Slope
  - Mg
  - Curvature
- Consistent over 4 years of data

Accuracy of prediction

- In 3 fields, accuracy ranged from 60 to 100% when predicting yield behavior

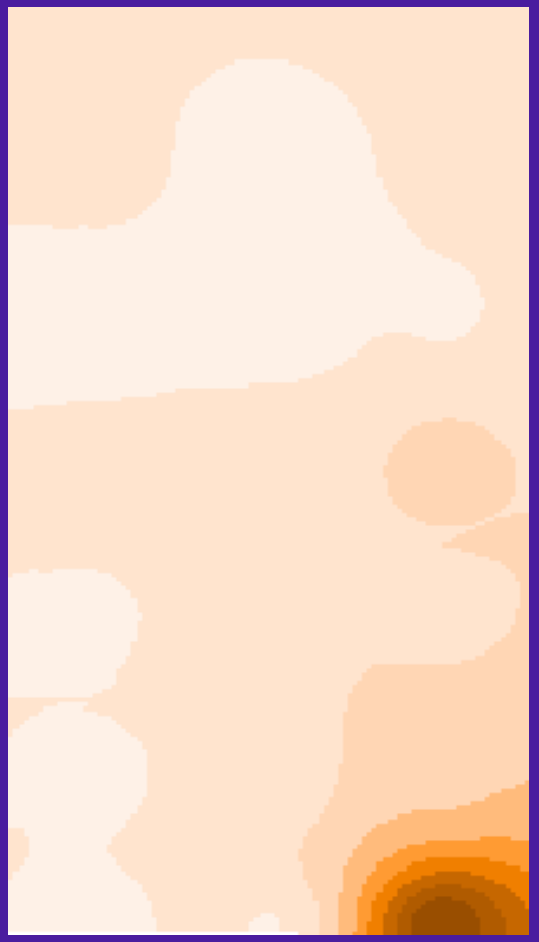
Field	High	Average	Low
1	88	70	83
2	100	60	83
3	82	71	67

Example: Field 1



Yield

pH



Potassium

What we've found

- Results may justify a variable rate application
  - Raise pH
  - Maintain K
- Decision must be made with yield goals for field
  - Do we try to get average yield up?
  - Do we work on low yielding areas?
  - Is it going to be profitable?

General Path to Understanding

- Gather as much information as possible
- Remember that yield/soil relationships may not be immediately clear
- Some soil/topographical properties affect yield but cannot be managed
  - Have to work around problem
- Keep ultimate goals in mind when making decisions