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# EC / EM Data for Salinity and Zones

Shawn Kasprick

Area Agronomist / Precision Ag Manager





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# Understanding EC / EM Data

- Types of equipment?
- What data is collected
  - Derived?
- Understanding the data
  - Cleaning the data
- Identifying Salinity
  - Soil Tests
  - Salinity Management



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## What is the Veris Cart?

- Electrical Conductivity
  - Voltage Drop
  - Soil Contact with Coulters



## What is the EM38?

- Electromagnetic Induction
  - Electromagnetic field
  - Non-Invasive

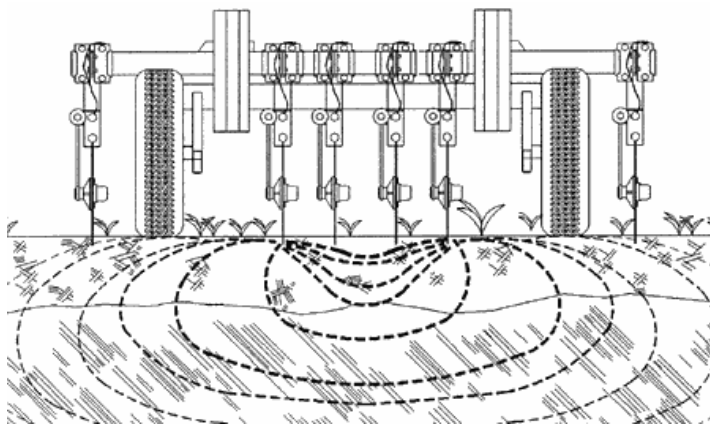




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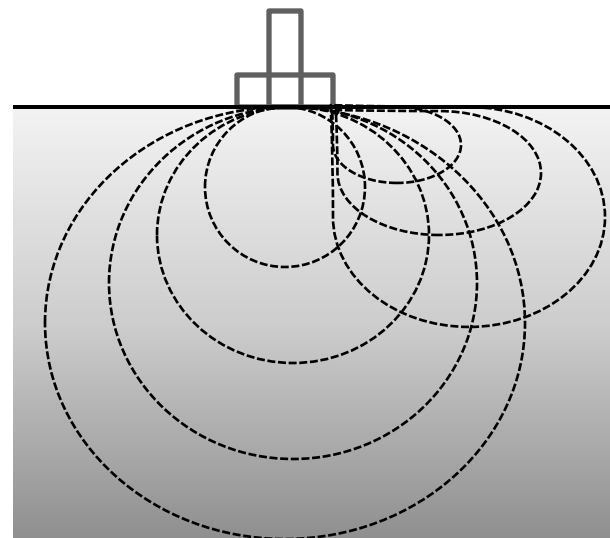
## What is the Veris Cart

- 6 coulters
- 1-2 inch depth
  - Soil Contact
- 15 mph
- 40-50 ft swaths



## What is the EM38

- Single or Dual Array
- No Soil Contact
- 15 mph
- 40-50 ft swaths





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# Veris Data

- Collected Data
  - Lat / Long
  - 0-1 Foot
  - 0-3 Foot
  - Elevation\*
- Derived Data
  - EC Subsoil
  - EC Index
  - Slope\*
  - Aspect\*
  - Relative Elevation\*
  - Soil Properties
    - Bulk Density
    - Salinity



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## EM38-DD Data

- Collected Data

- Lat / Long
- 0 - .75 Meter
- 0 - 1.5 Meter
- Elevation\*

- Derived Data

- EM Subsoil
- EM Index
- Slope\*
- Aspect\*
- Relative Elevation\*
- Soil Properties
  - Bulk Density
  - Salinity



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# What do the readings mean?

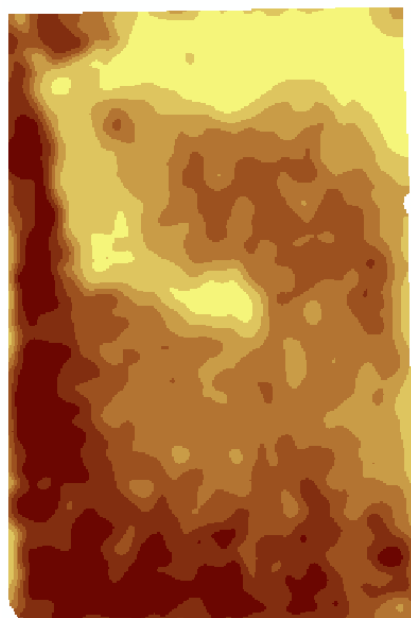
- Relative Values
  - Dependent
    - Moisture
    - Texture
    - OM
    - Salts
- Must look at relationships
  - Spatial (Maps)
  - Statistical (Correlation)
    - Yield
    - Imagery
    - Topography
  - Explained Agronomically?

Long	Lat	EC01	EC03	Elevation
-97.50924900	48.57194300	36.2	50.5	260.9
-97.50933100	48.57194900	45.0	48.4	261.4
-97.50936800	48.57195300	41.9	48.4	261.6
-97.50940100	48.57195600	26.7	50.1	261.8
-97.50943200	48.57196000	18.0	42.6	262.1

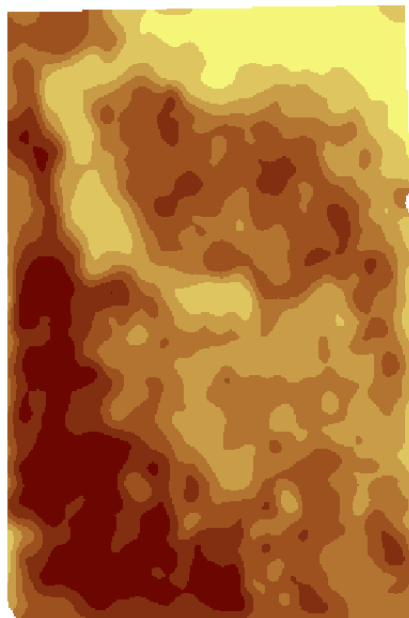


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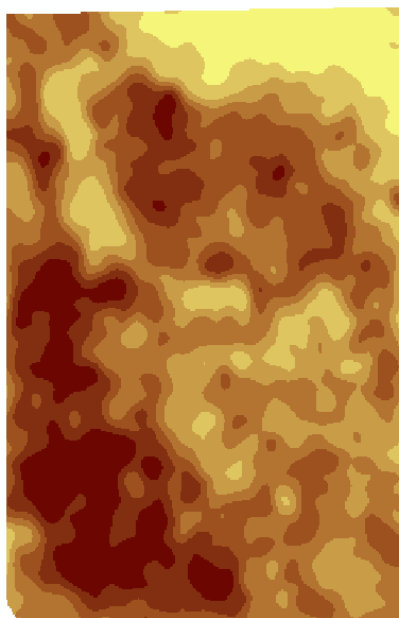
# EC Maps and Derivatives



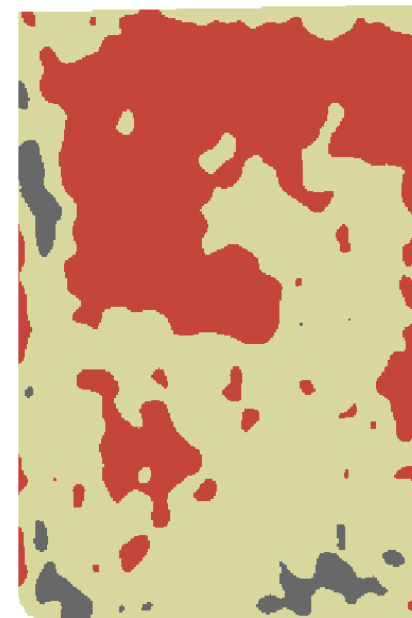
Shallow






Deep



Subsoil



Index

-  Lighter Subsoil
-  Uniform Profile
-  Heavier Subsoil

- Patterns due to what?

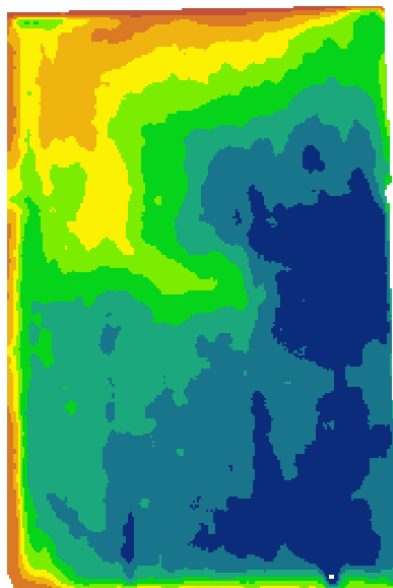
- Moisture
- OM
- Texture
- Salts



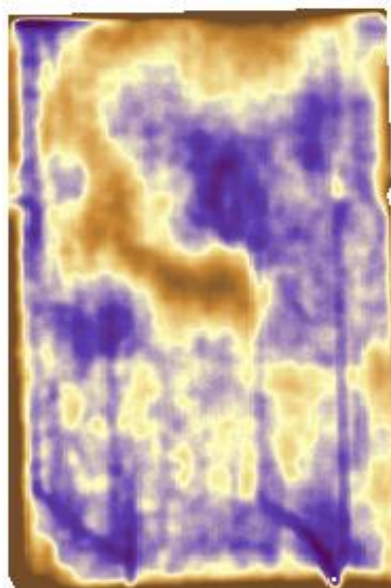
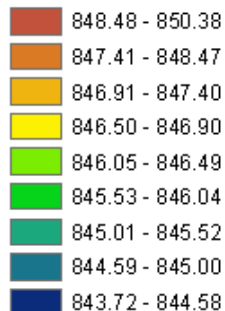


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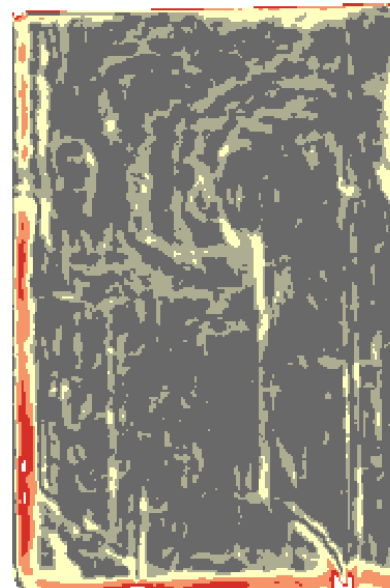
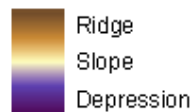
# EC Maps and Derivatives



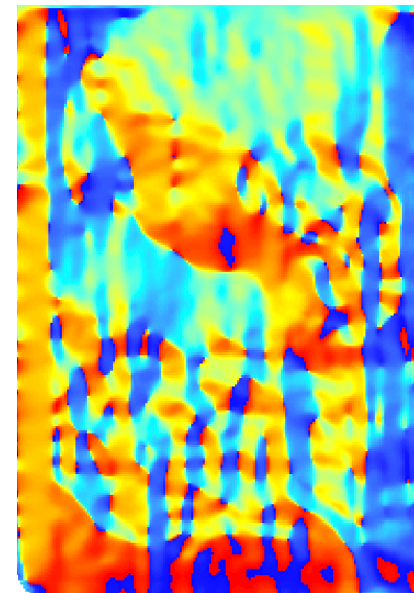
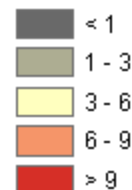
**Elevation (Feet)**



**Relative Elevation**



**Slope (Percent)**



**Aspect**

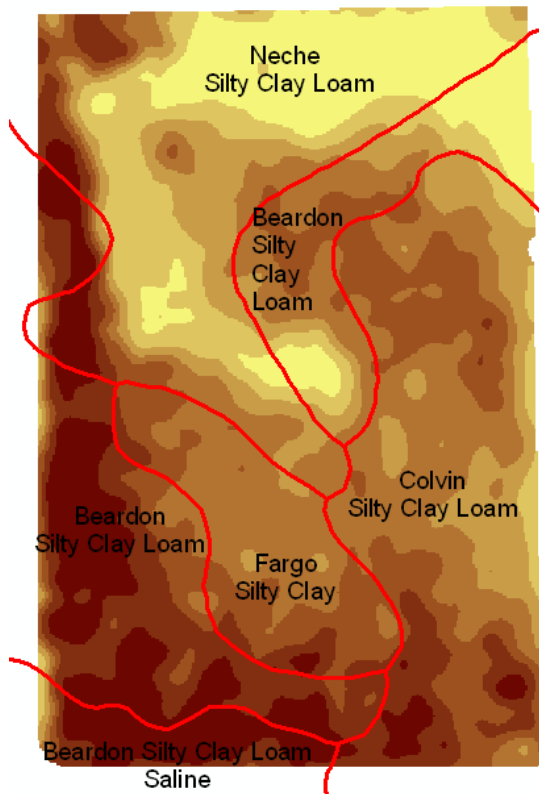




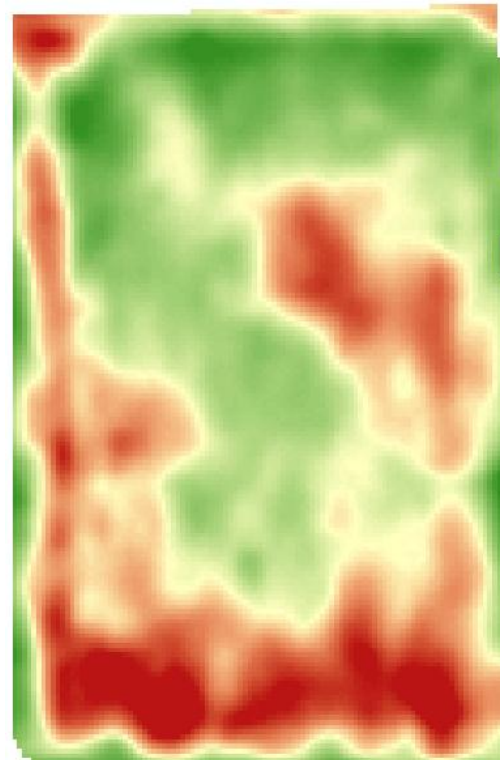
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# Spatial Relationships

- Soil Types



- Crop Growth



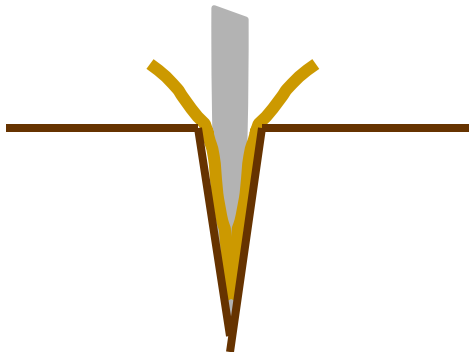
$R^2: - 0.74$



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# Cleaning Data

- Veris
  - Maintain Contact
    - Rough Fields
    - Disconnection in system
  - Residue
    - Hair pinning
- EM
  - Calibration
  - Electromagnetic Interference
    - Metals
      - Wiring
      - Pipes (Irrigation)
      - Vehicle or Sled

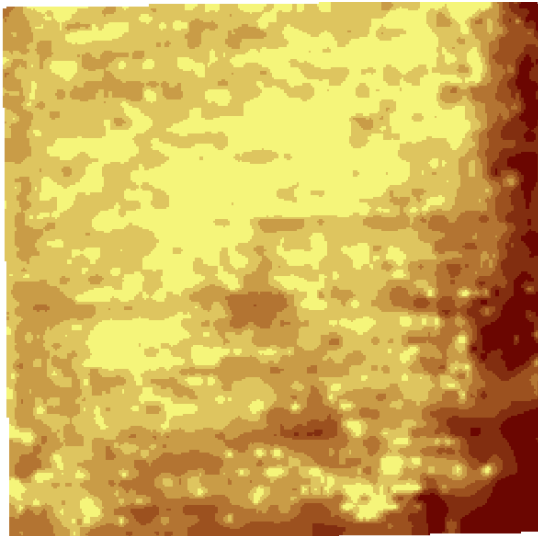




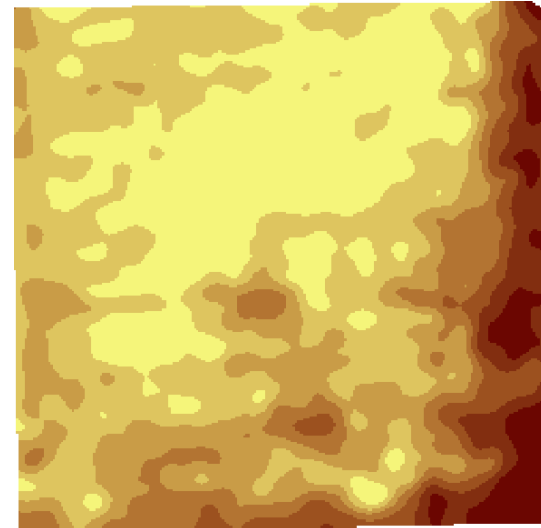
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# Cleaning Data

- Raw Data
  - Excessive Residue
- Cleaned Data
  - Removed Errors



- Causes problems through all layers



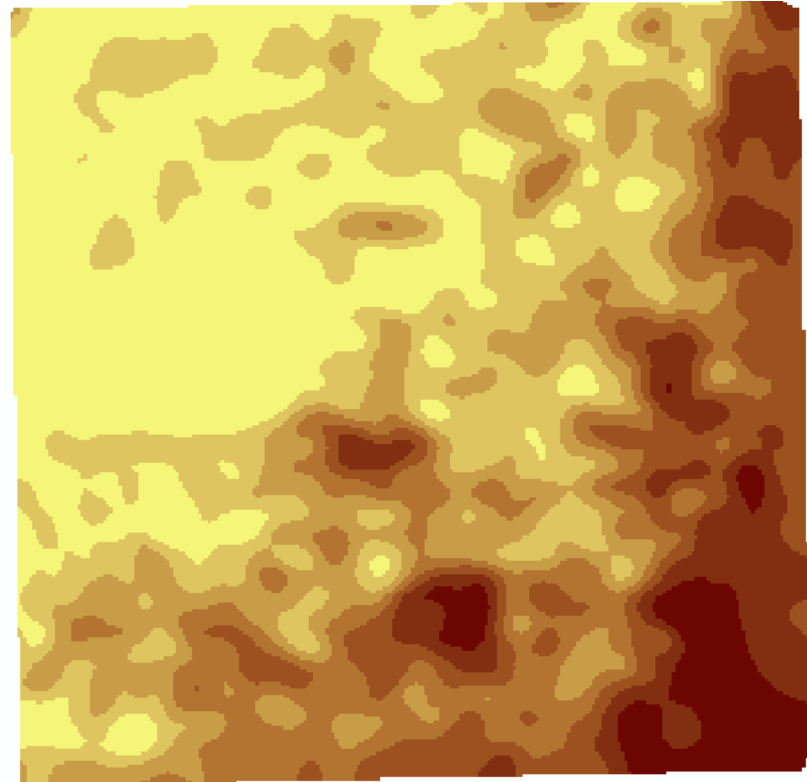
- Now can make better decisions!



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# Salinity Identification

- Agronomy is Key
  - Process of Elimination
    - Moisture
      - Topography
      - Imagery or Yield
    - Soil Texture
      - Soil Type
    - OM
      - Soil Test
    - Salinity
      - Soil Test
      - Imagery or Yield

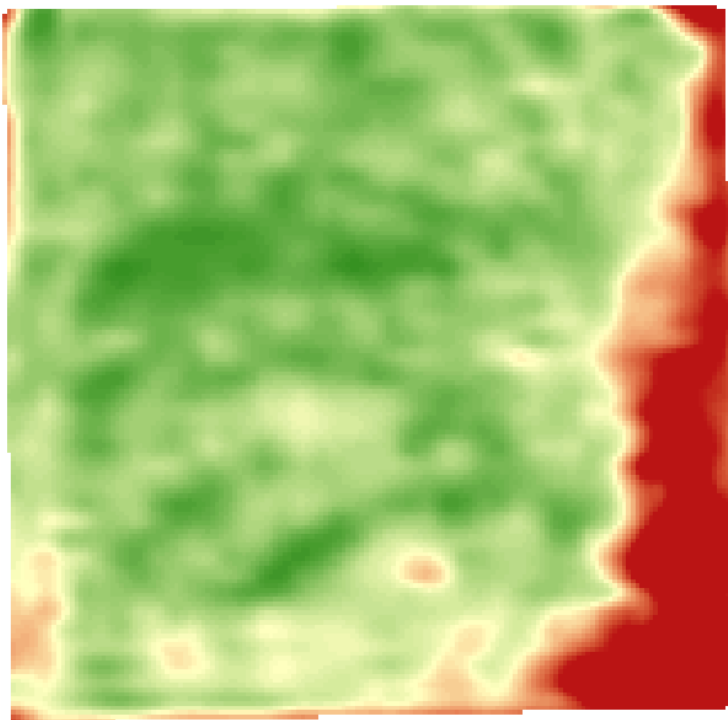




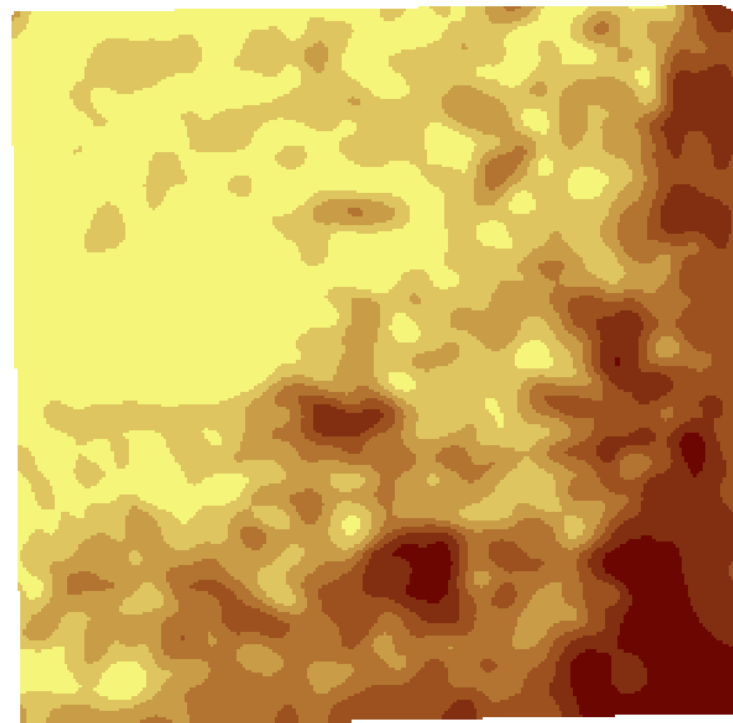
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# Crop Reference

- Imagery



- EC Layer



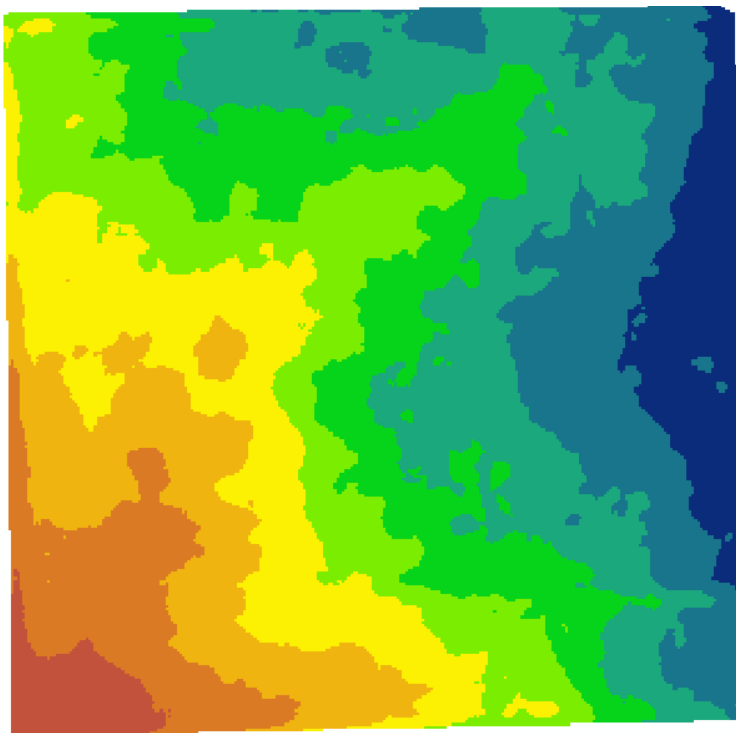
$R^2: -0.76$



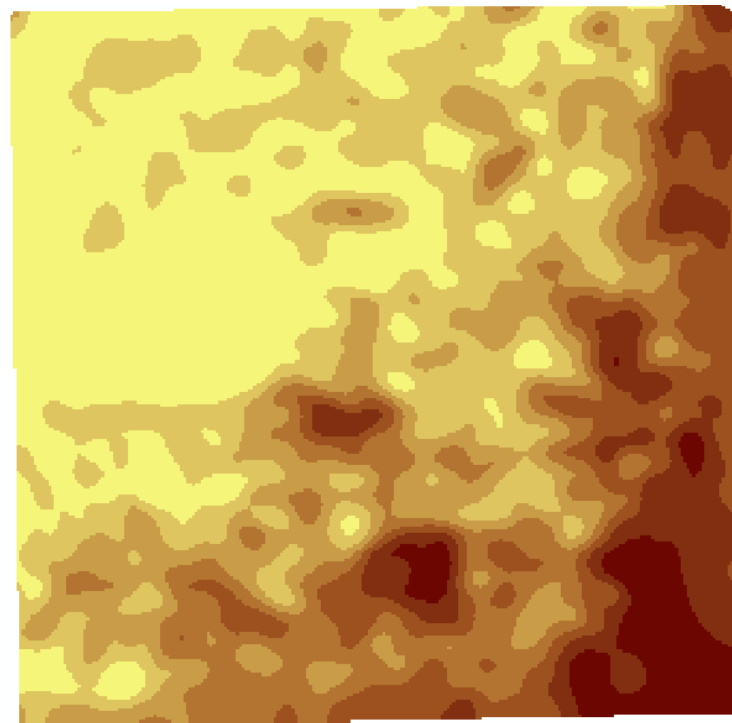
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# Moisture

- Elevation



- EC Layer



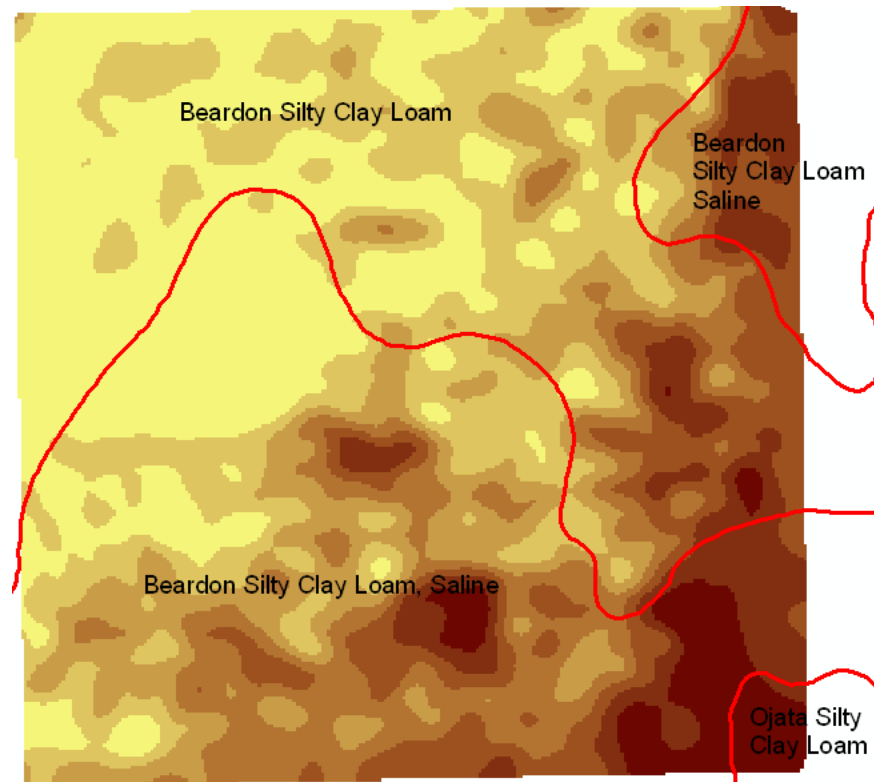
$R^2: 0.38$



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# Soil Texture

- SSURGO
  - Order 2 Survey
    - General Info
    - Still Very Good
  - Only used as a visual reference
  - EC/EM Data
    - More accurate Soil Types
    - Find Inclusions



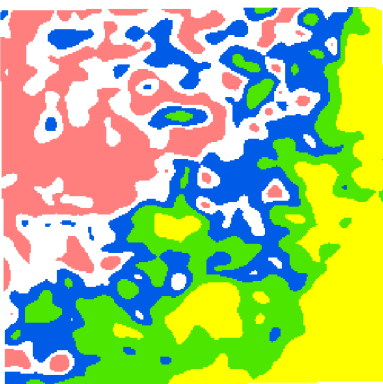




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# Soil Test

Zone ID	OM	pH	Soil Texture			CEC (Amm. Acetate)	Salt 0-6	Salt 6-24	CCE (%)	CEC (Na Saturation)
			Sand	Silt	Clay					
Red	5.4	7.8	15	41	44	44.6	1.18	2.19	1.6	50.0
White	5.8	7.9	13	43	44	46.9	1.16	2.50	3.1	50.8
Blue	5.4	7.9	15	43	42	46.0	1.23	2.27	2.1	48.0
Green	5.8	7.9	13	43	44	57.7	2.73	3.08	4.1	46.8
Yellow	5.4	8.0	15	45	40	79.4	3.33	3.98	6.4	43.0



- Inflated CEC values due to High salinity and carbonates

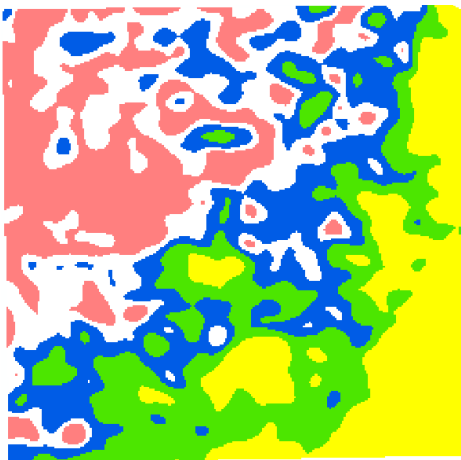
True CEC Method  
Washes out Salts  
Na, Ca, and Mg



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# Soil Test

Zone ID	Salt 0-6	Salt 6-24	CCE (%)	Calcium	Magnesium	Sodium
Red	1.18	2.19	1.6	6976	1022	87
White	1.16	2.50	3.1	7400	1044	106
Blue	1.23	2.27	2.1	6927	1203	150
Green	2.73	3.08	4.1	8908	1373	242
Yellow	3.33	3.98	6.4	12155	1822	625



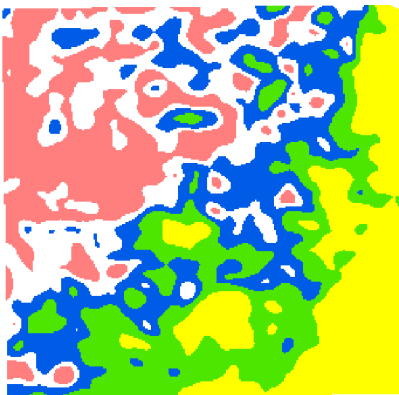
- Types of Salts
  - Sulfates
  - Carbonates
  - Chlorides



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# Soil Test

Zone ID	Salt 0-6	Salt 6-24	Yield Potential			
			Corn	Soybeans	Wheat	Sugarbeets
Red	1.18	2.19	> 52 %	> 50 %	> 82 %	> 85 %
White	1.16	2.50	> 46 %	> 50 %	> 83 %	> 86 %
Blue	1.23	2.27	> 49 %	> 47 %	> 81 %	> 85 %
Green	2.73	3.08	~ 8 %	~ 0 %	~ 45 %	~ 55 %
Yellow	3.33	3.98	~ 0 %	~ 0 %	~ 30 %	~ 42 %



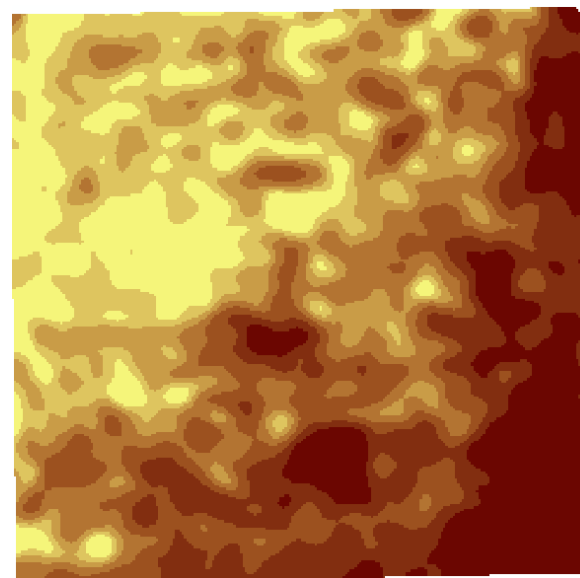
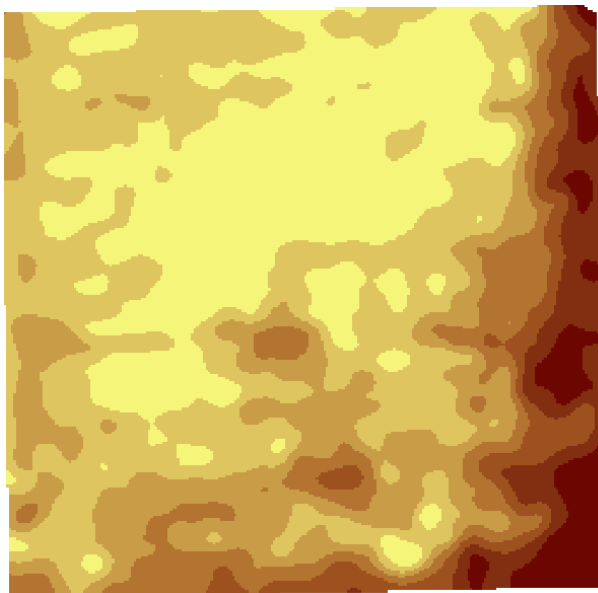
- Lost Yield Potential
  - Root Stress
    - Less Moisture Uptake
    - Less Nutrient Uptake
    - More Heat Stress



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# Crop Growth Effects

- EC Shallow
  - Germination Issues
- EC Subsoil
  - Restricted Root Growth

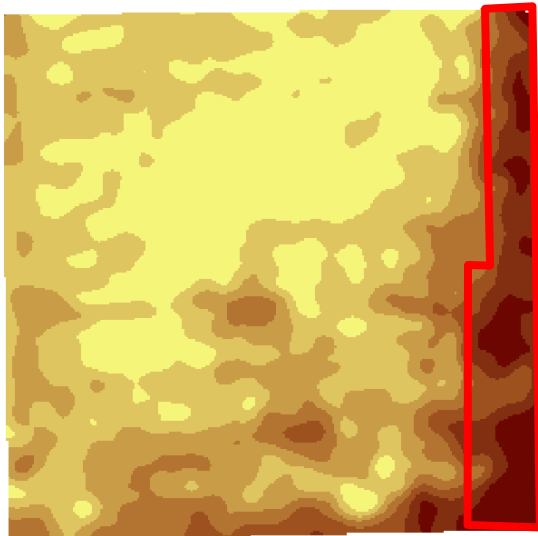




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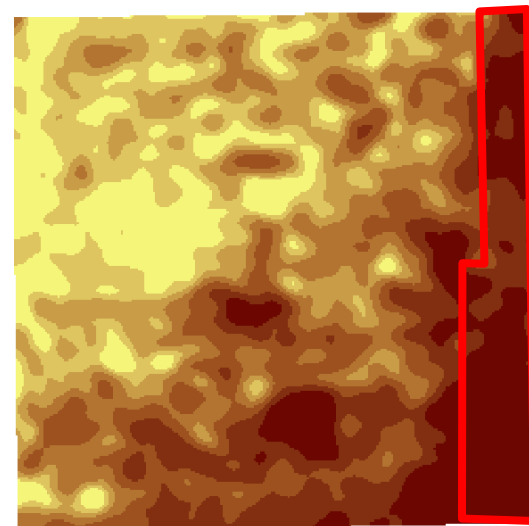
# Crop Growth Effects

- EC Shallow
  - Unplanted or crop loss



- Must manage area

- EC Subsoil
  - No overall effect



- Salinity Creep...



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# Managing Salts

- Manage Water
  - Deep Rooted Crops
    - Sugarbeets
  - Tolerant Crops
    - Barley
    - Sugarbeets
  - Late Season Crops
  - More Surface Residue
    - Reduced Till
    - Strip Till
  - NO Fallow
  - CRP
    - Other Programs??
  - Drainage
    - Surface
    - Tile



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# Understanding EC / EM Data

- More potential layers
  - Derivatives
- Need Agronomy!
  - Understand the Data
  - Use Multiple Layers
    - Imagery
    - Topography
- Identify Extents of Salinity
  - Surface vs. Subsoil
- Help manage salinity
  - Do Not Leave Bare Soil!



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Questions??