



Bringing Earth's Resources to Life

EC / EM Data for Salinity and Zones

Shawn Kasprick

Area Agronomist / Precision Ag Manager





Bringing Earth's Resources to Life

Understanding EC / EM Data

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



Bringing Earth's Resources to Life

What is the Veris Cart?

- Electrical Conductivity
 - Voltage Drop
 - Soil Contact with Coulters



What is the EM38?

- Electromagnetic Induction
 - Electromagnetic field
 - Non-Invasive

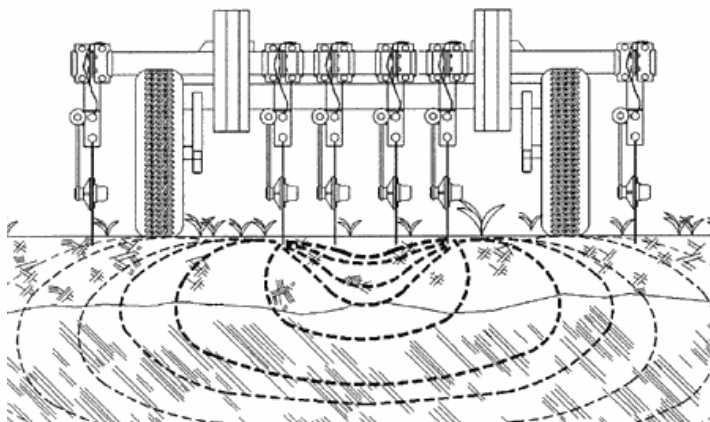




Bringing Earth's Resources to Life

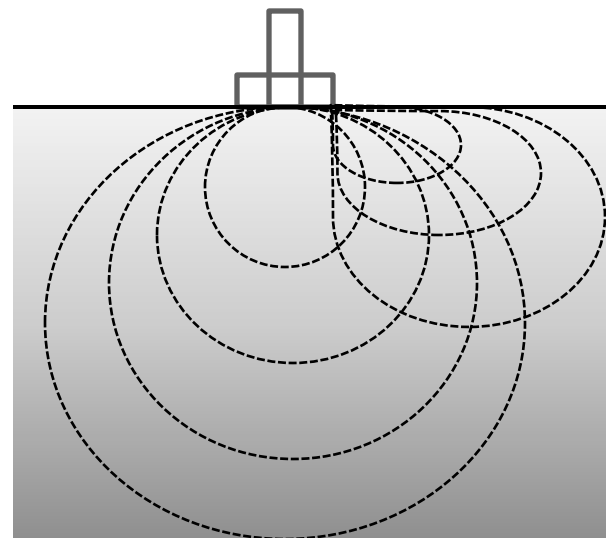
What is the Veris Cart

- 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





Bringing Earth's Resources to Life

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



Bringing Earth's Resources to Life

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



Bringing Earth's Resources to Life

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

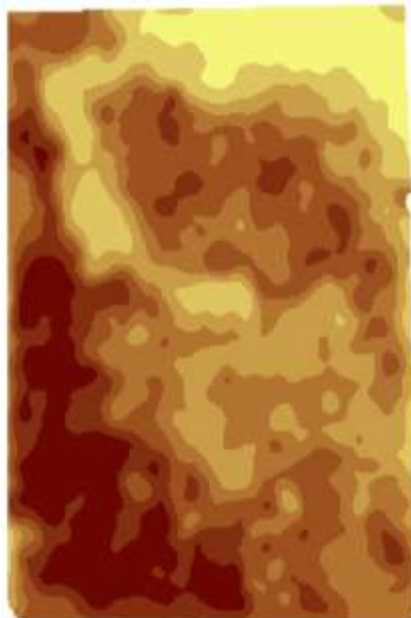


Bringing Earth's Resources to Life

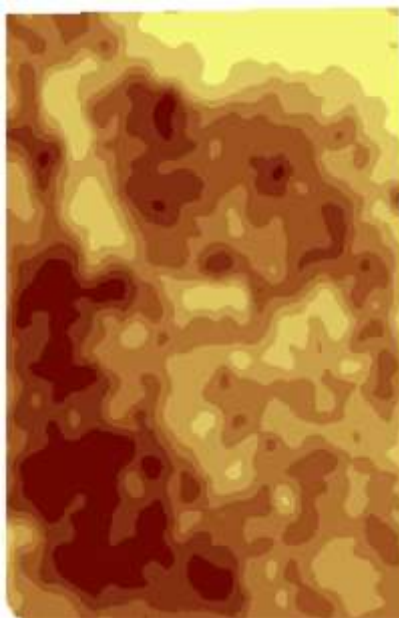
EC Maps and Derivatives



Shallow






Deep



Subsoil



Index

-  Lighter Subsoil
-  Uniform Profile
-  Heavier Subsoil

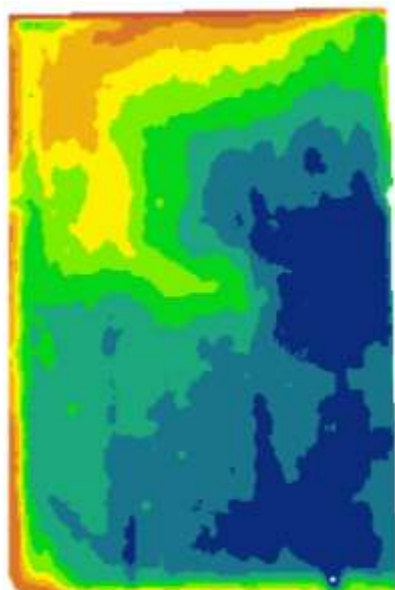
- Patterns due to what?

- Moisture
- OM
- Texture
- Salts

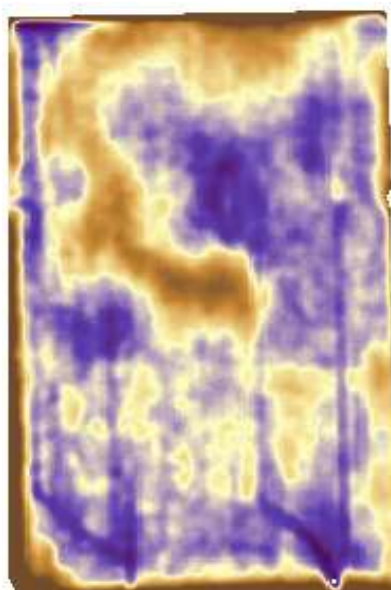
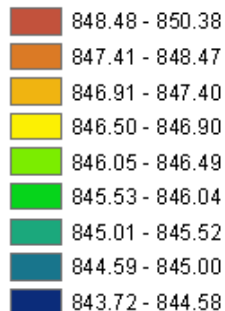


Bringing Earth's Resources to Life

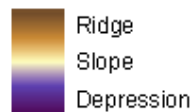
EC Maps and Derivatives



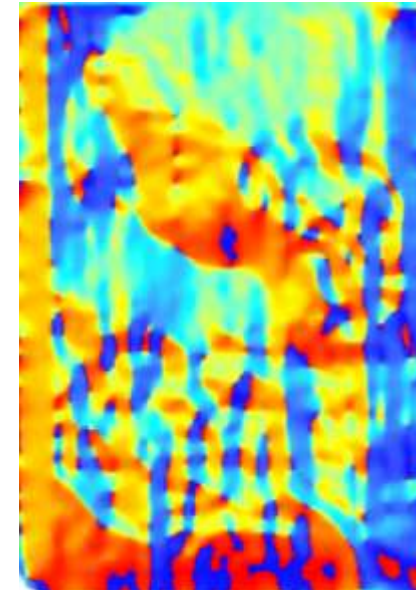
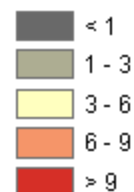
Elevation (Feet)



Relative Elevation



Slope (Percent)



Aspect

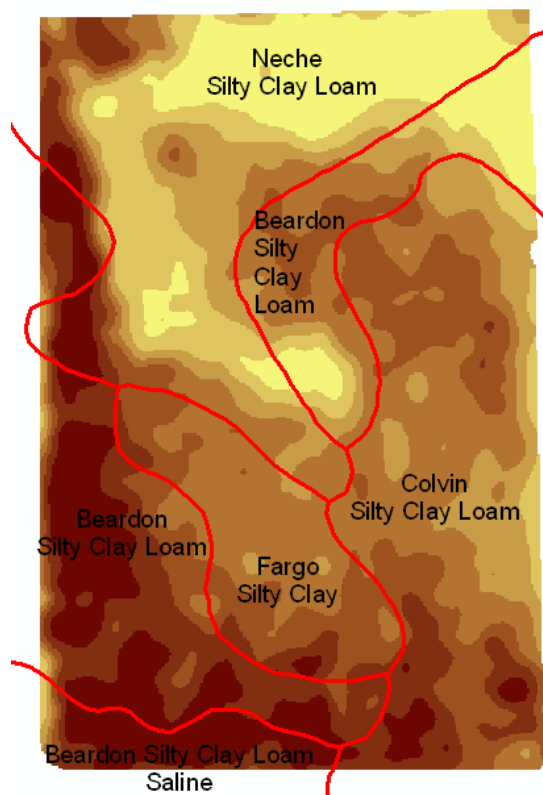




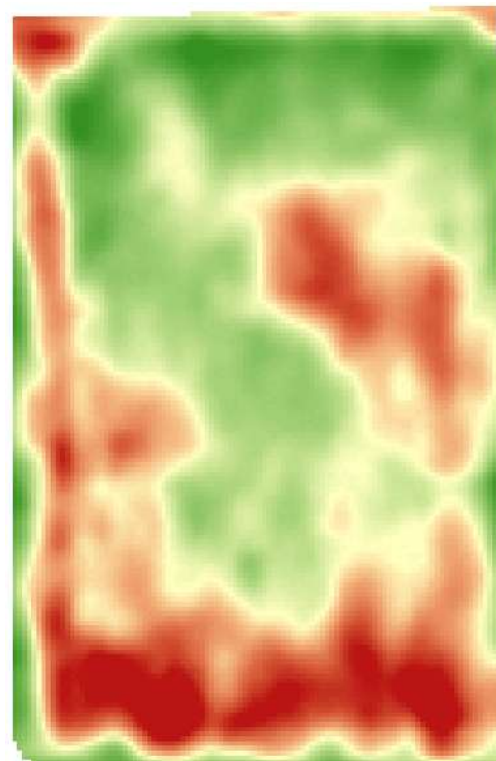
Bringing Earth's Resources to Life

Spatial Relationships

- Soil Types



- Crop Growth



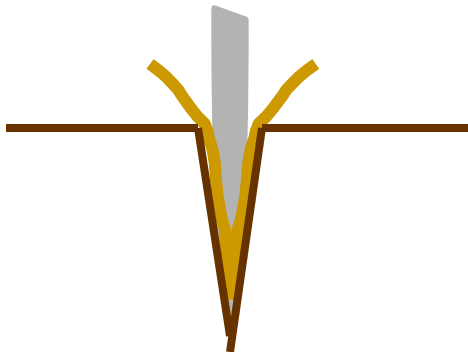
$R^2: -0.74$



Bringing Earth's Resources to Life

Cleaning Data

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

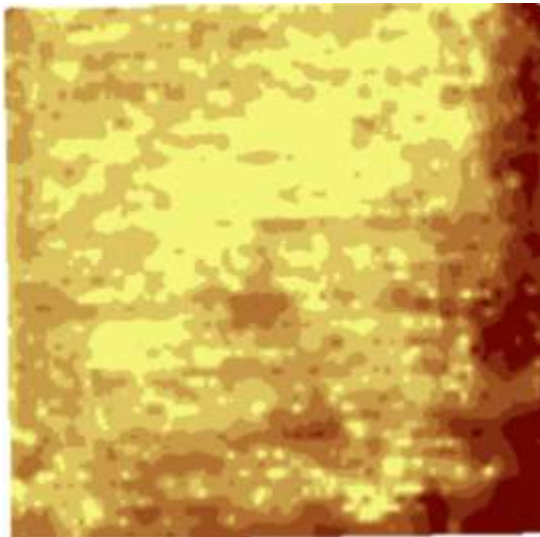




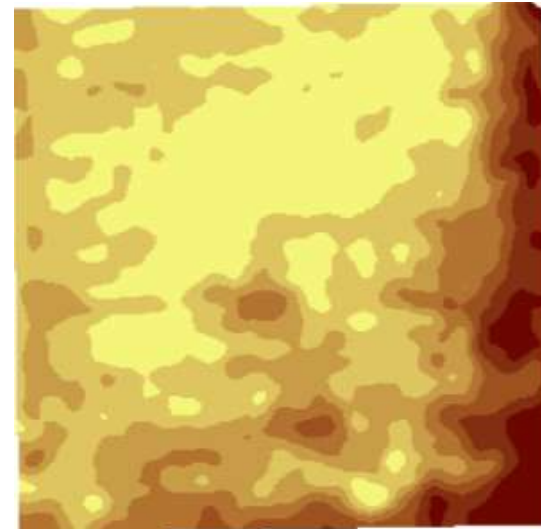
Bringing Earth's Resources to Life

Cleaning Data

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



- Causes problems through all layers



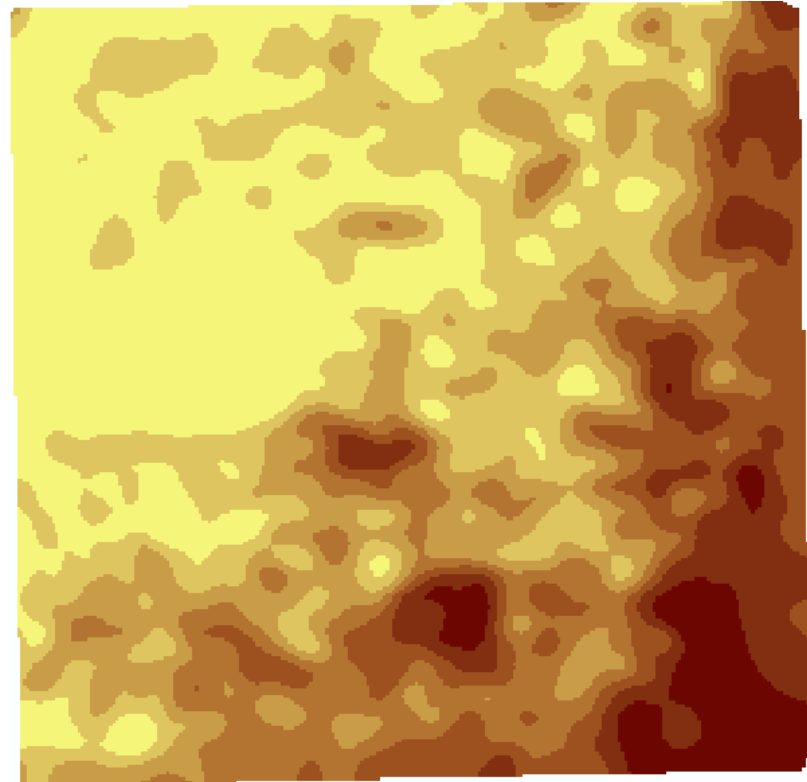
- Now can make better decisions!



Bringing Earth's Resources to Life

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

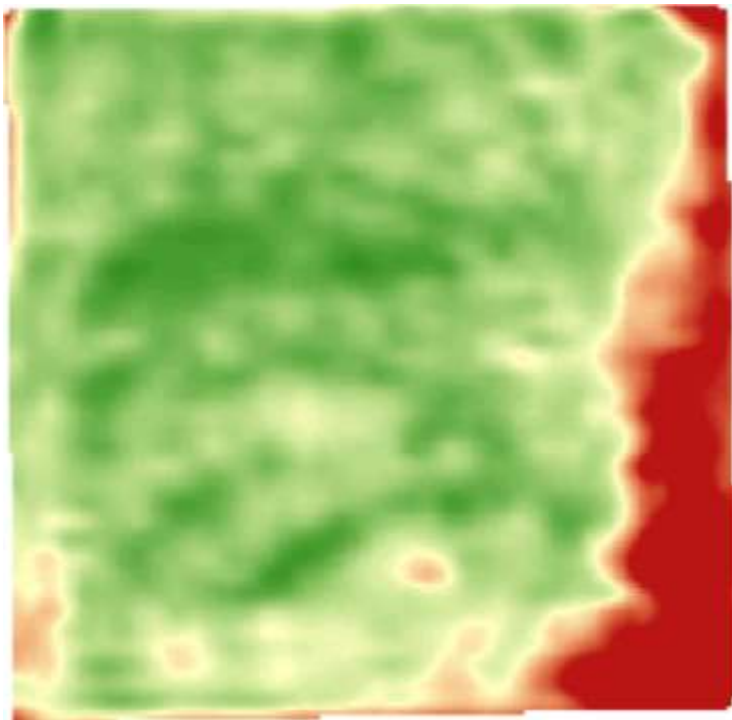




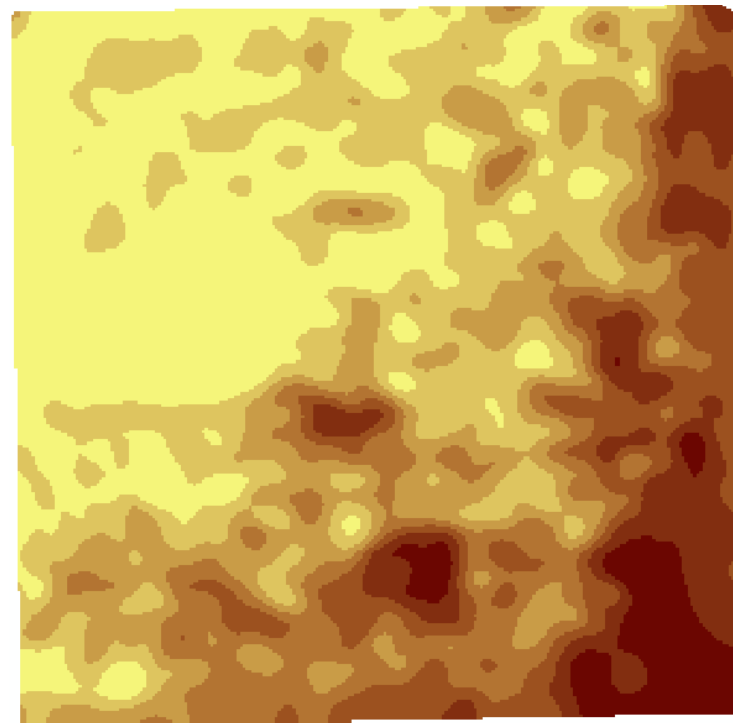
Bringing Earth's Resources to Life

Crop Reference

- Imagery



- EC Layer



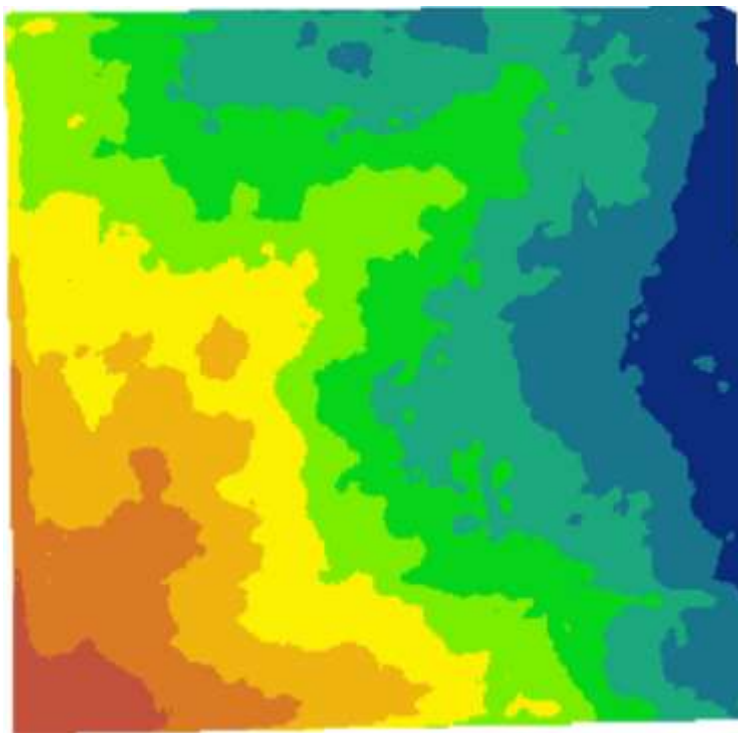
$R^2: -0.76$



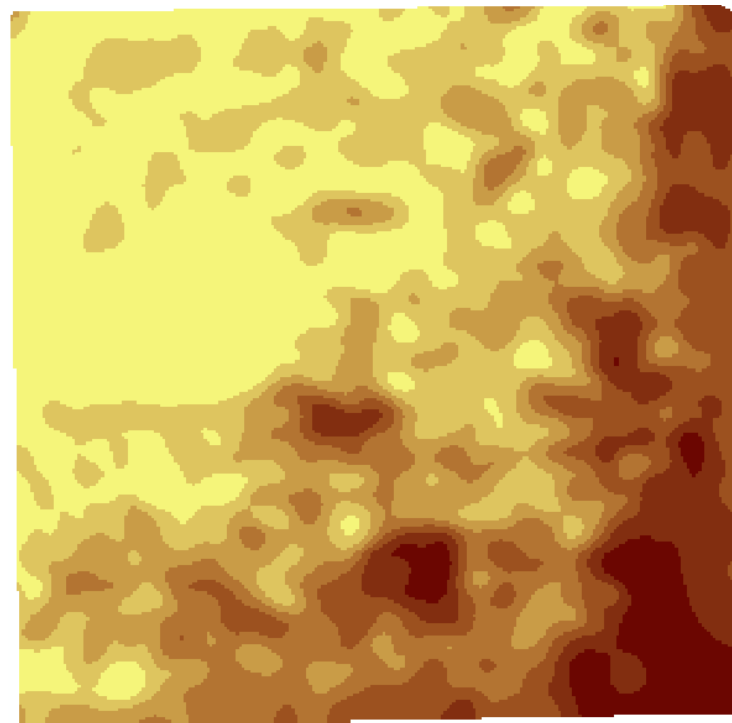
Bringing Earth's Resources to Life

Moisture

- Elevation



- EC Layer



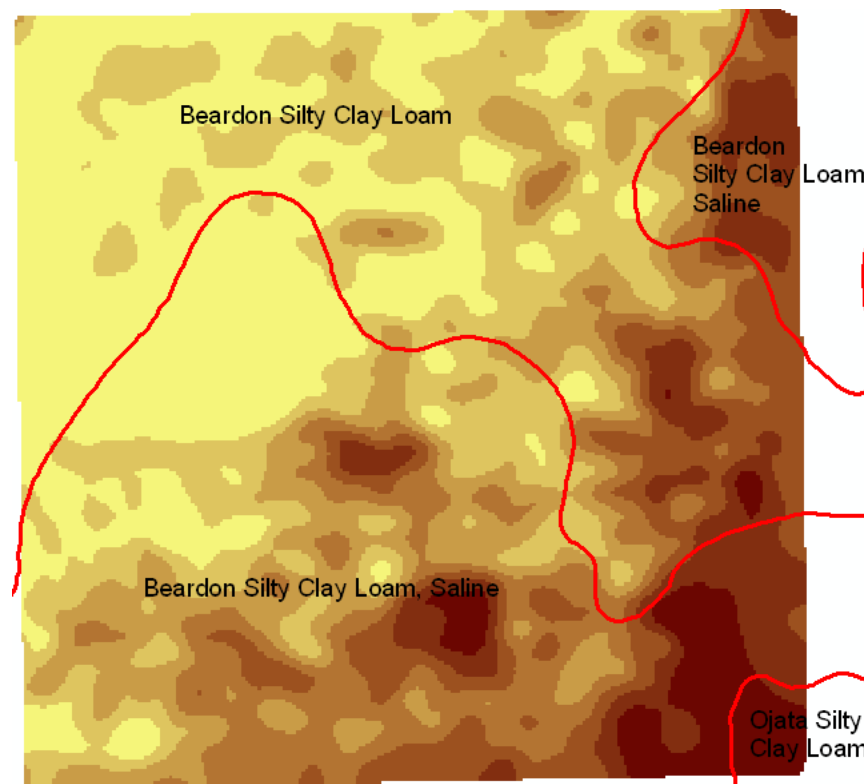
$R^2: 0.38$



Bringing Earth's Resources to Life

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

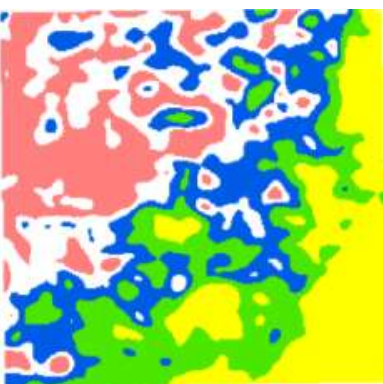




Bringing Earth's Resources to Life

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

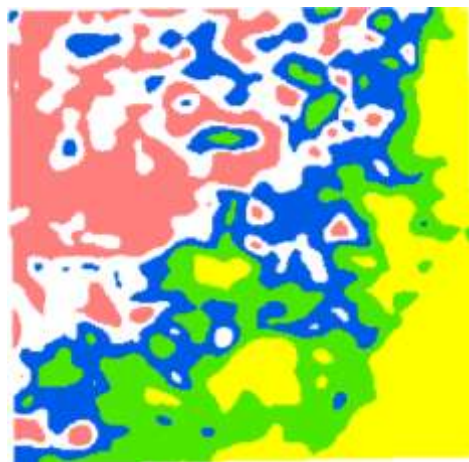
True CEC Method Washes out Salts Na, Ca, and Mg



Bringing Earth's Resources to Life

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



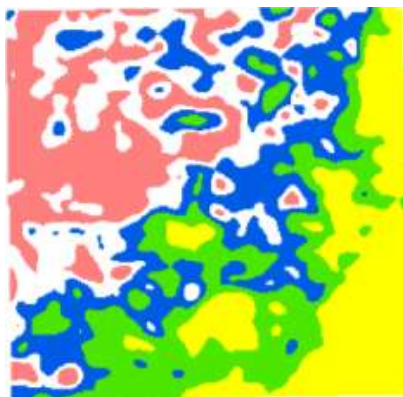
- Types of Salts
 - Sulfates
 - Carbonates
 - Chlorides



Bringing Earth's Resources to Life

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 %



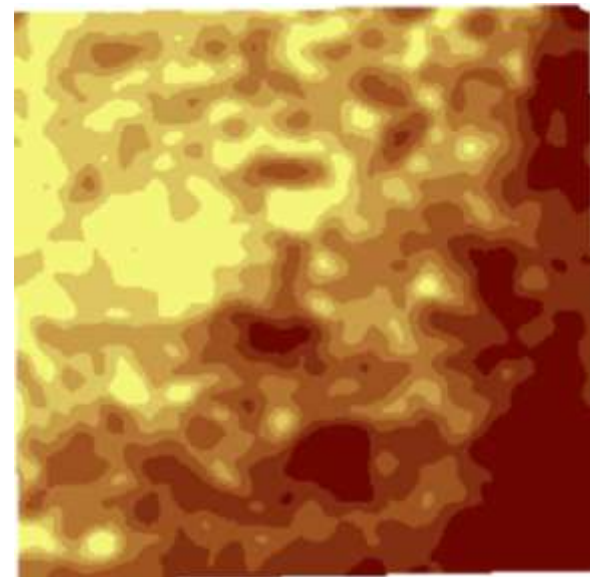
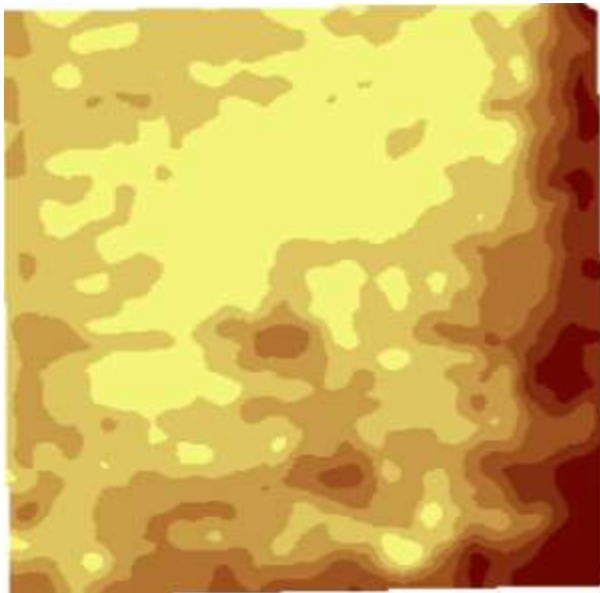
- Lost Yield Potential
 - Root Stress
 - Less Moisture Uptake
 - Less Nutrient Uptake
 - More Heat Stress



Bringing Earth's Resources to Life

Crop Growth Effects

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

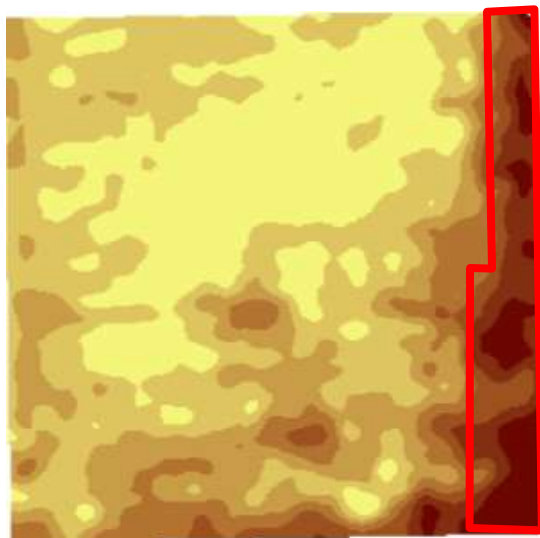




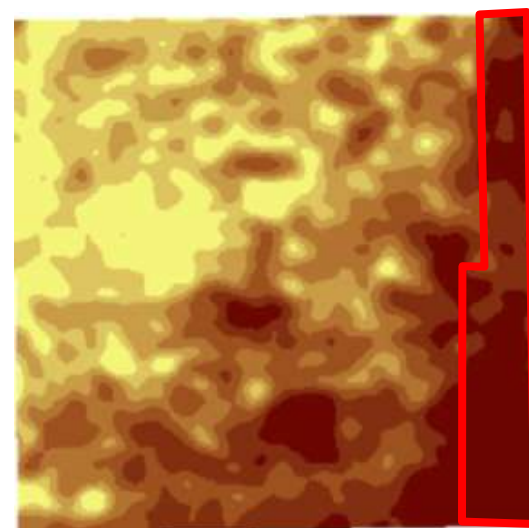
Bringing Earth's Resources to Life

Crop Growth Effects

- EC Shallow
 - Unplanted or crop loss
- EC Subsoil
 - No overall effect



- Must manage area



- Salinity Creep...



Bringing Earth's Resources to Life

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



Bringing Earth's Resources to Life

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!



Bringing Earth's Resources to Life

Questions??