

# Precision Irrigation Management: *Challenges and Opportunities*



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# Introduction

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## Why Irrigate?

- Increase yield and profit
- Stabilize yield and assist with budgeting
- Reduce overall production risk
- Agronomics



# Introduction

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- In 2017, South Carolina had approx. 13% of cropland irrigated (210,000 acres)
    - Commodity specific
      - High value crops have larger percentage of irrigated acres
  - Relatively low irrigated acreage compared to other southern states
    - Georgia – 1.1 million acres irrigated
    - Mississippi – 1.6 million acres irrigated
  - On-going water/irrigation survey 2018-2019
  - Water applied for irrigation has increased in SE USA more in last 10 years than other regions of USA
- USDA-NASS*



# Irrigation Water Sources in SC

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- Surface Water Reservoirs ~ 38%
  - Important for SC Piedmont and Coastal Plain
  - Ponds and Lagoons
- Underground Aquifers ~ 62%
  - Important for SC Coastal Plain
  - 6 Major Aquifers in SC
- Irrigation is 4<sup>th</sup> greatest user of water in SC
- Irrigation is 2<sup>nd</sup> greatest user of groundwater



*SC Water Assessment - SCDNR*



# Water Use Efficiency

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## Ways to Increase WUE:

- 1. Increase irrigation system efficiency**
2. Utilize an irrigation scheduling method/tool
3. BMPs to capture rainfall/irrigation and prevent runoff
4. Improve genetics/plant ability to use water more efficiently



# Precision Irrigation

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- Precision technologies are evolving rapidly
- Many new management tools/options available
  - Whole-farm Wi-Fi and connectivity
  - Soil moisture sensors
  - System automation
  - Variable rate systems

*“Our precision capabilities have exceeded our decision making capabilities”*

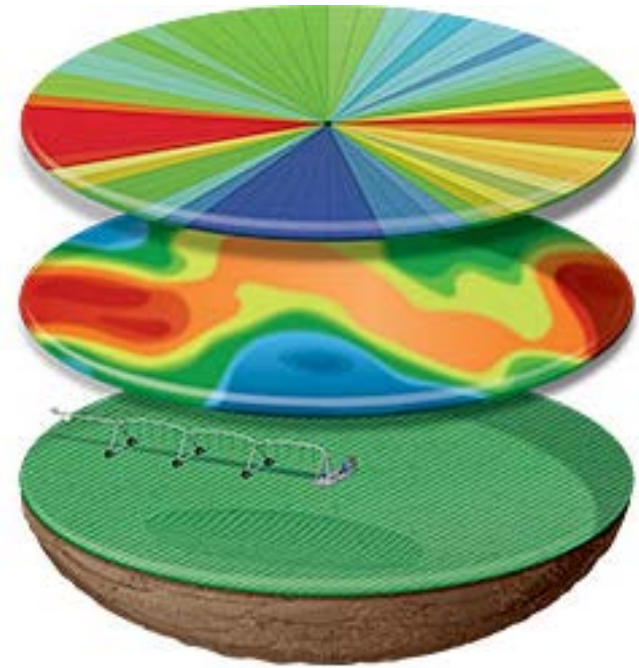


# Variable Rate Irrigation

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## What is Variable Rate Irrigation?:

- Site-Specific Management of Water
- The ability to spatially vary irrigation depth across field to account for variability
- Applying water where you want it





# Precision Irrigation

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1. Does VR Irrigation work in every field?
2. Does the water/pumping savings provide acceptable ROI?
3. How do we accurately and repeatedly make prescriptions?
4. Base prescription on soil characteristic or crop? NDVI?





# Variable Rate Irrigation

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## 2 Types of VR Irrigation:

### 1. Section/Speed Control

- Speed up – Slow down to adjust application depth
- Whole system approach with “pie-shaped zones”
- Vary application rate/depth based on field topography, non-crop areas, or distinct soil texture differences

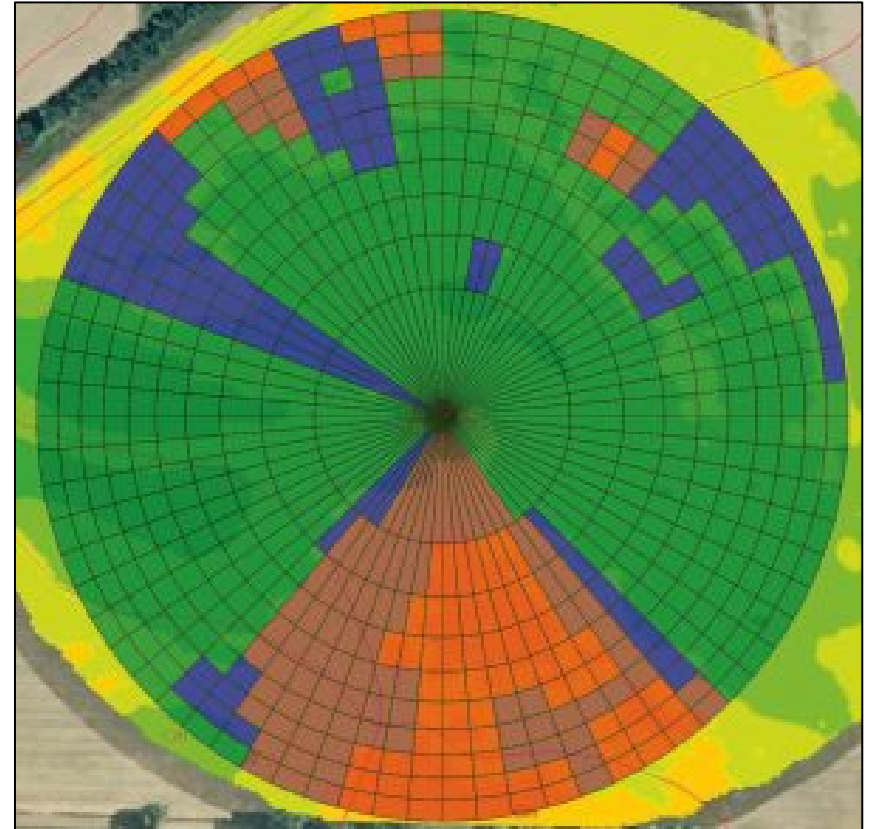
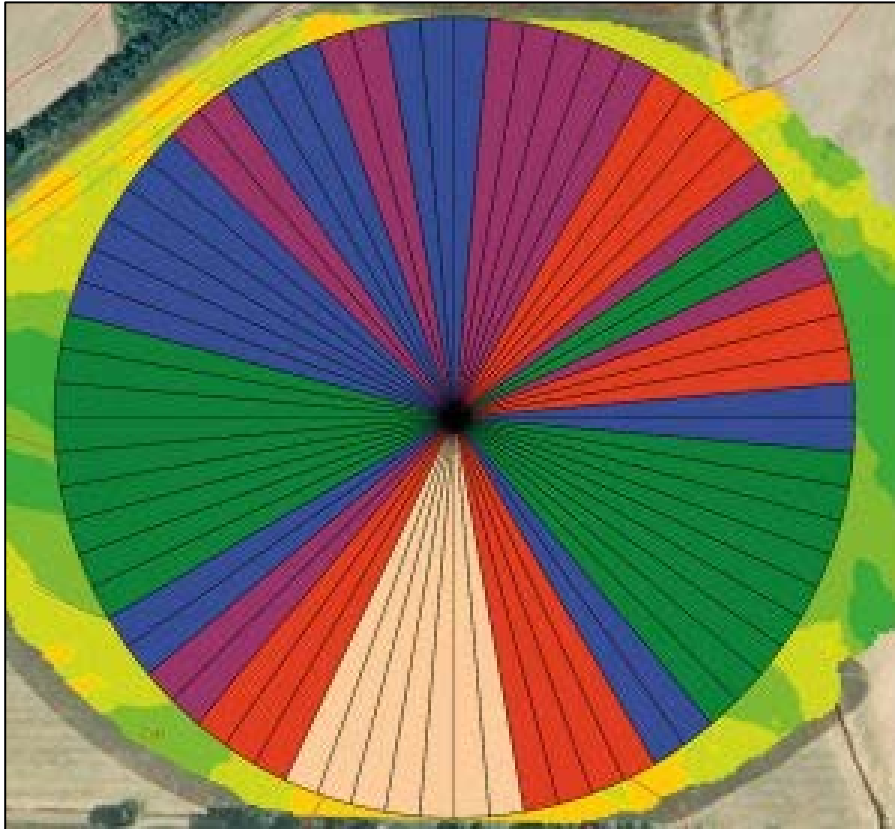
### 2. Zone Control

- Solenoids on sprinklers coupled with speed vary rate
- Greater resolution on size and shape of management zones
- Able to account for irregular shaped zones



# Variable Rate Irrigation

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*pivotirrigation.com*



# Variable Rate Irrigation

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## 2 Types of Prescriptions:

- 1. Static** – Prescription stays the same throughout the growing season
  - On/Off
  - Distinct differences in soil texture
- 2. Dynamic** – Prescription changes frequently during the season
  - Complex management
  - Maximizes profit
  - Possibly changes each irrigation



# Variable Rate Irrigation

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## When do I need variable rate irrigation?

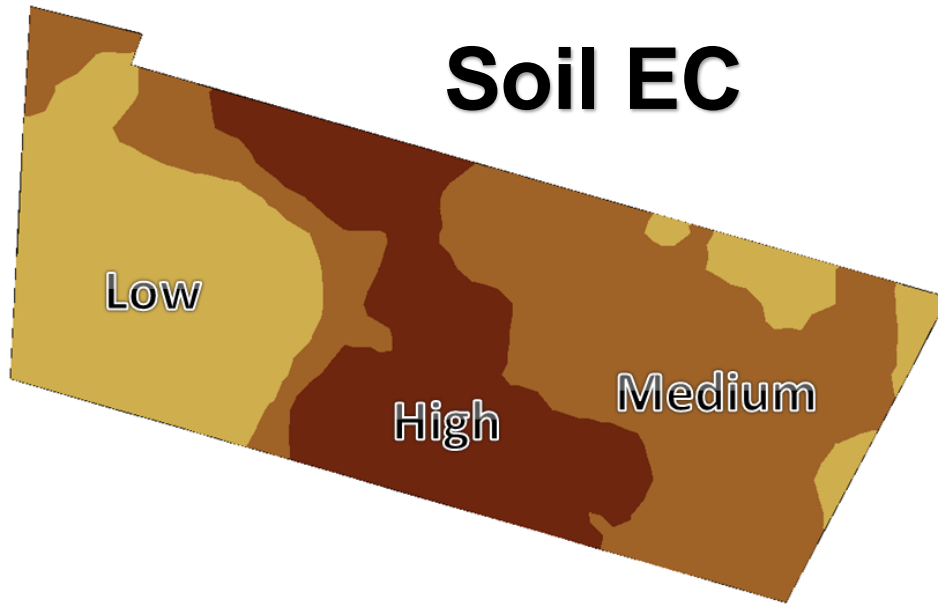
- Significant soil texture variability under irrigation system
- Variations in topography
- Non-crop areas
- Multiple crops under same system
- Water regulation and/or limited water supply
- Field by field basis – Not all fields are suitable for VR



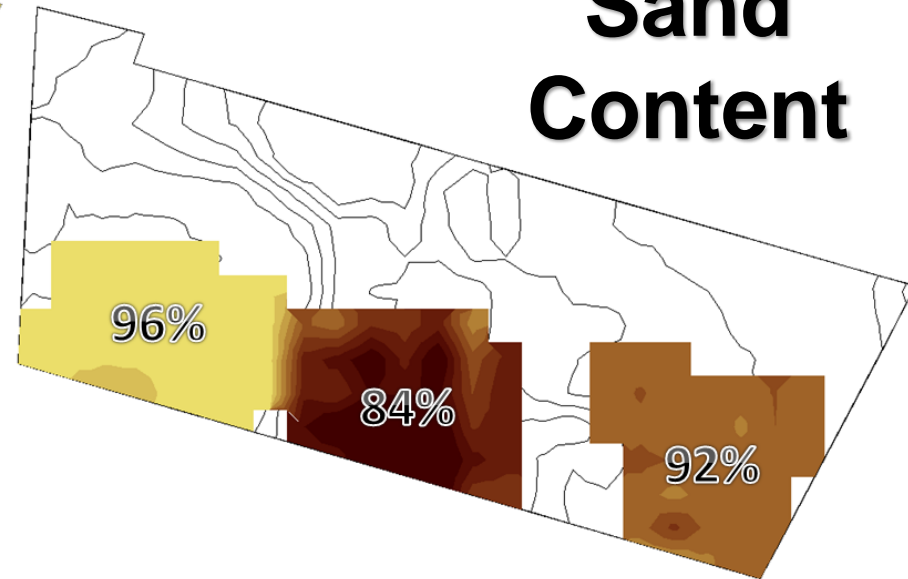
# Variable Rate Irrigation

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## Soil EC

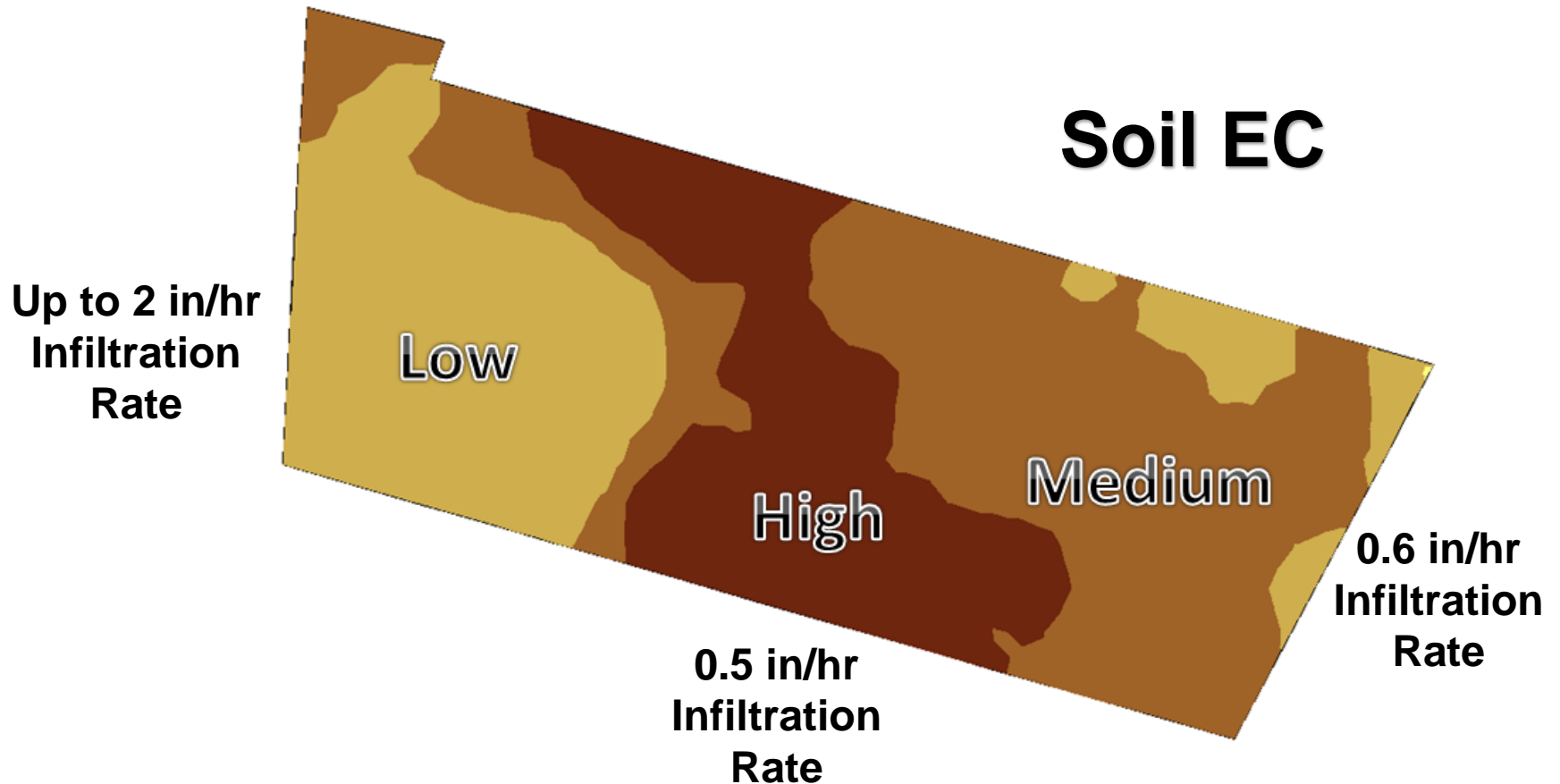


## Sand Content



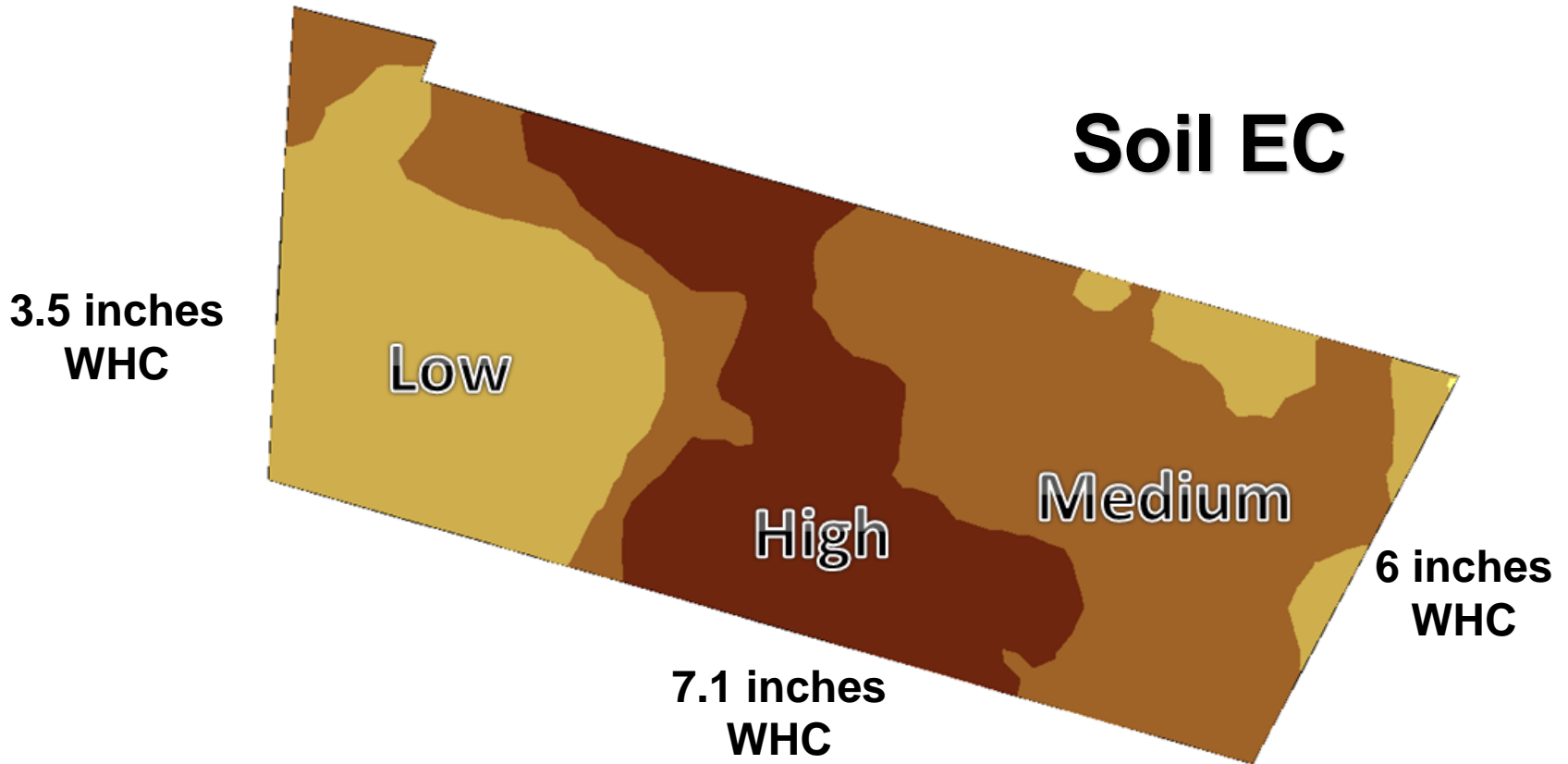
# Variable Rate Irrigation

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# Variable Rate Irrigation

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# Variable Rate Irrigation

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Factors to consider when varying irrigation application rates:

- How much do we vary application rate by soil texture?
- If using sensors, do we establish thresholds for each soil texture? Base trigger off one threshold? Skip over areas of the field?
- Frequent applications likely needed
  - Capacity of the system is factor



# Variable Rate Irrigation - Research

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- VR irrigation research is available across U.S.
- Water savings up to 25% have been observed with VRI when compared to uniform irrigation
  - Highly dependent on field and variability
- Most of the research conducted evaluates VRI vs. conventional systems
- Limited research on determining when VRI is appropriate
  - How much variability do we need to justify?



# Variable Rate Irrigation - Research

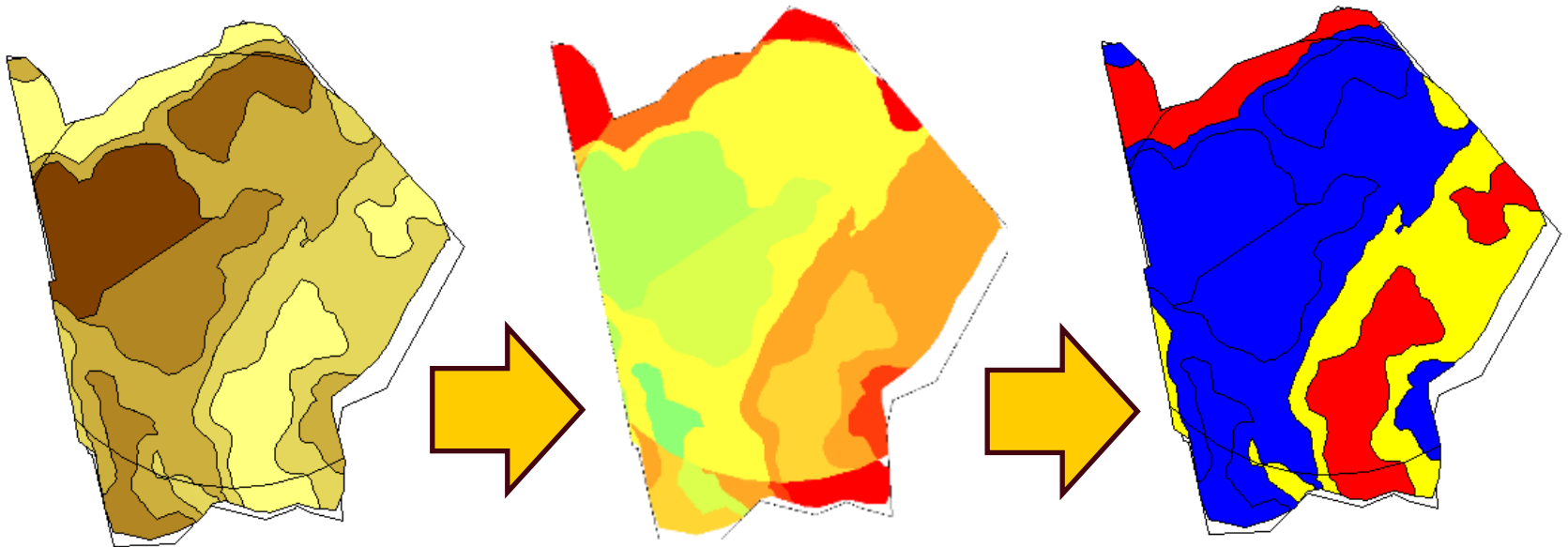
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- Additional research is needed to evaluate prescription development and repeatability
- Directed  $R_x$  – A method to develop variable rate prescriptions
- Utilize existing tools and recommendations for VR prescriptions and implementation

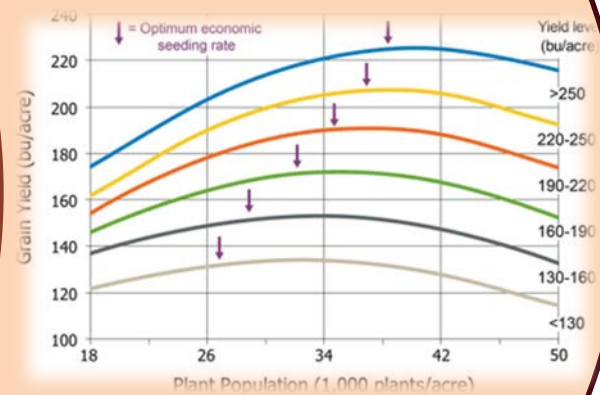
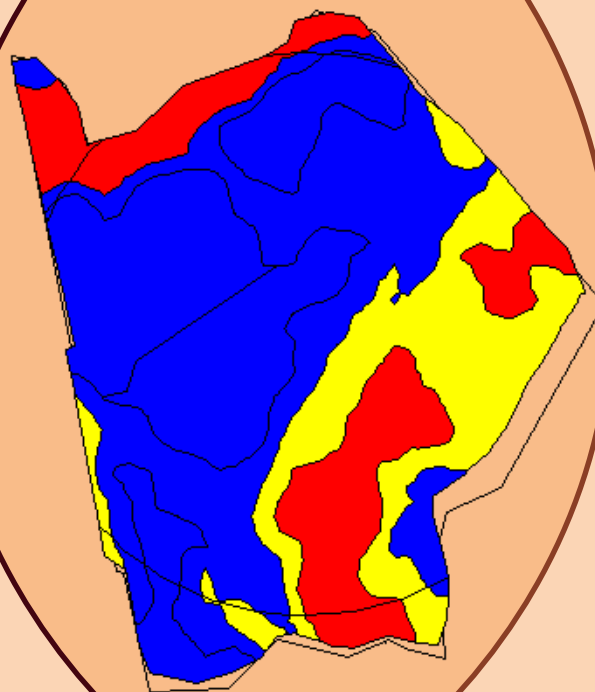
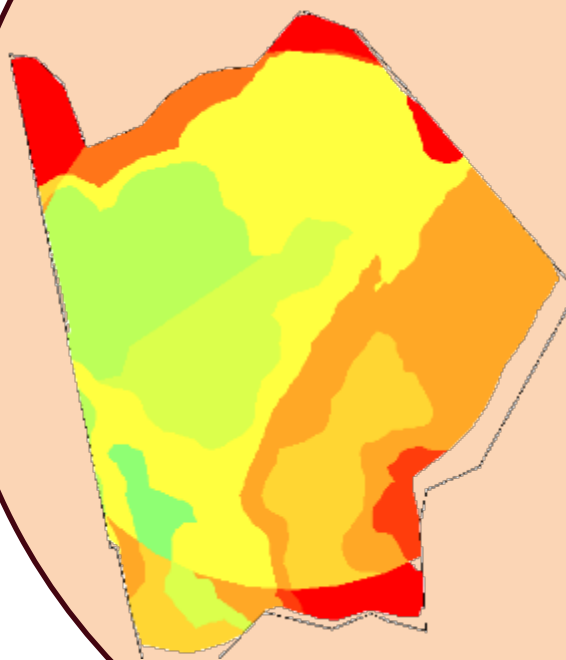


# Typical Steps in Developing Variable Rate Prescriptions

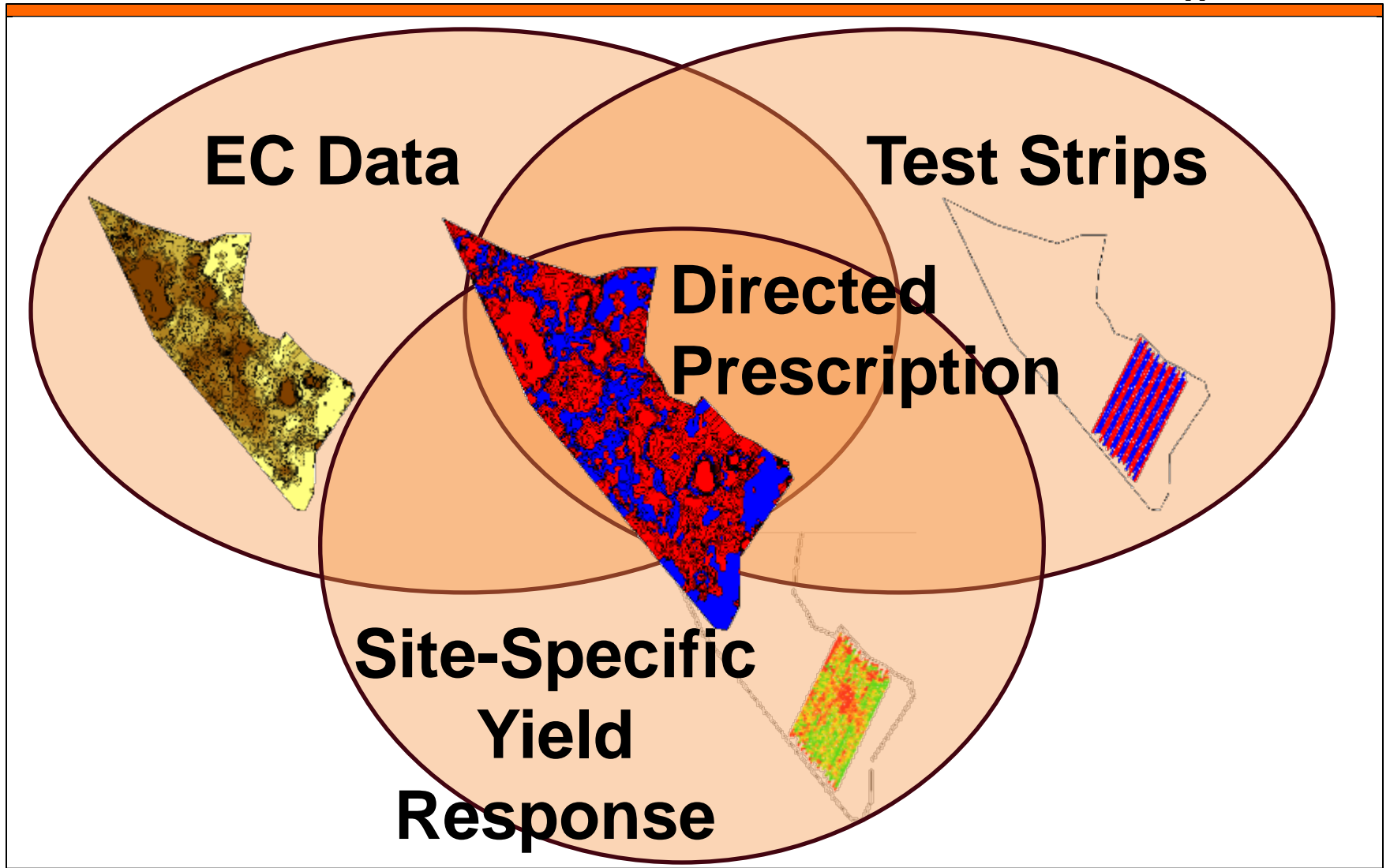
1. Zone Development
2. Productivity Assessment by Zone
3. Rate Assignment
4. Rate Assessment



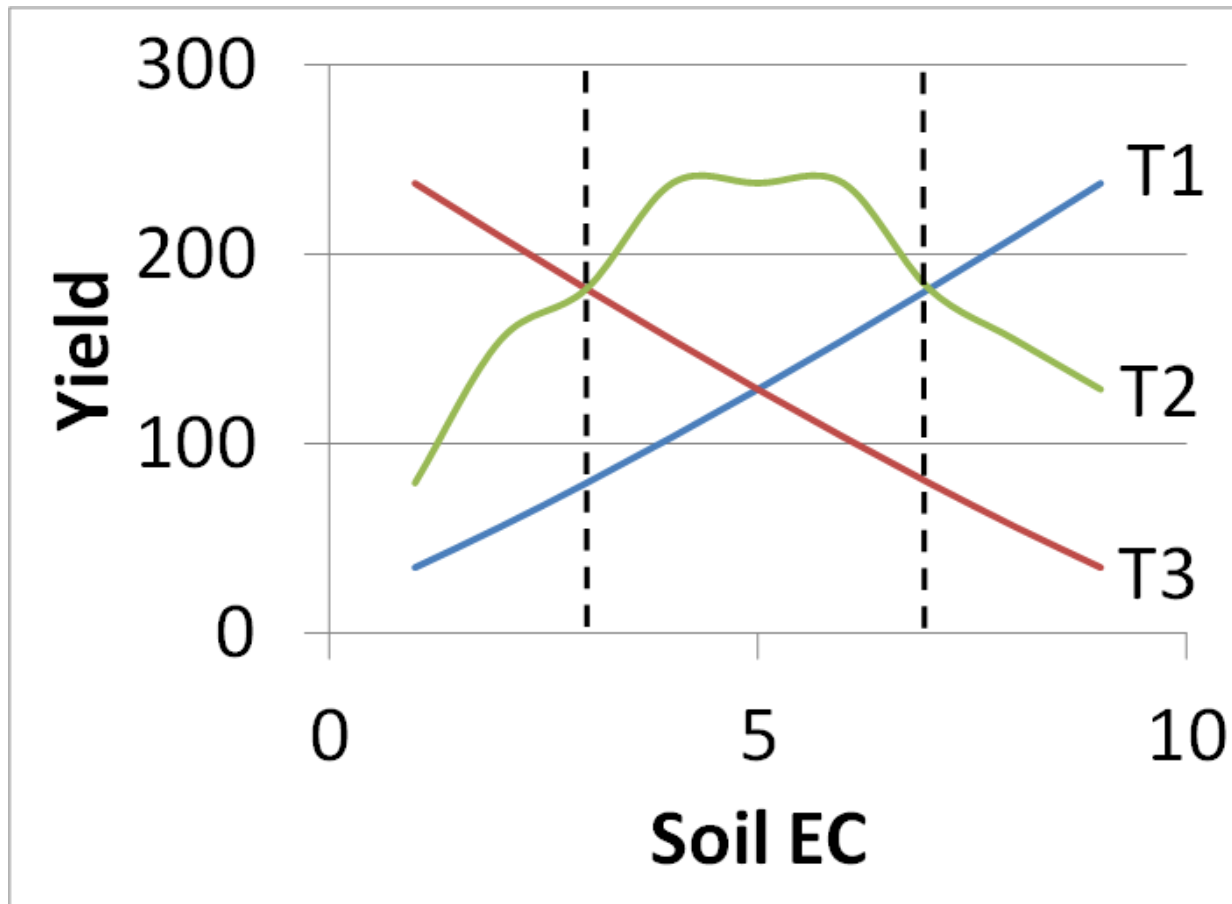
# Prescription Then Based on Generic Data



# The Clemson "Directed Prescription" System (D-R<sub>x</sub>)

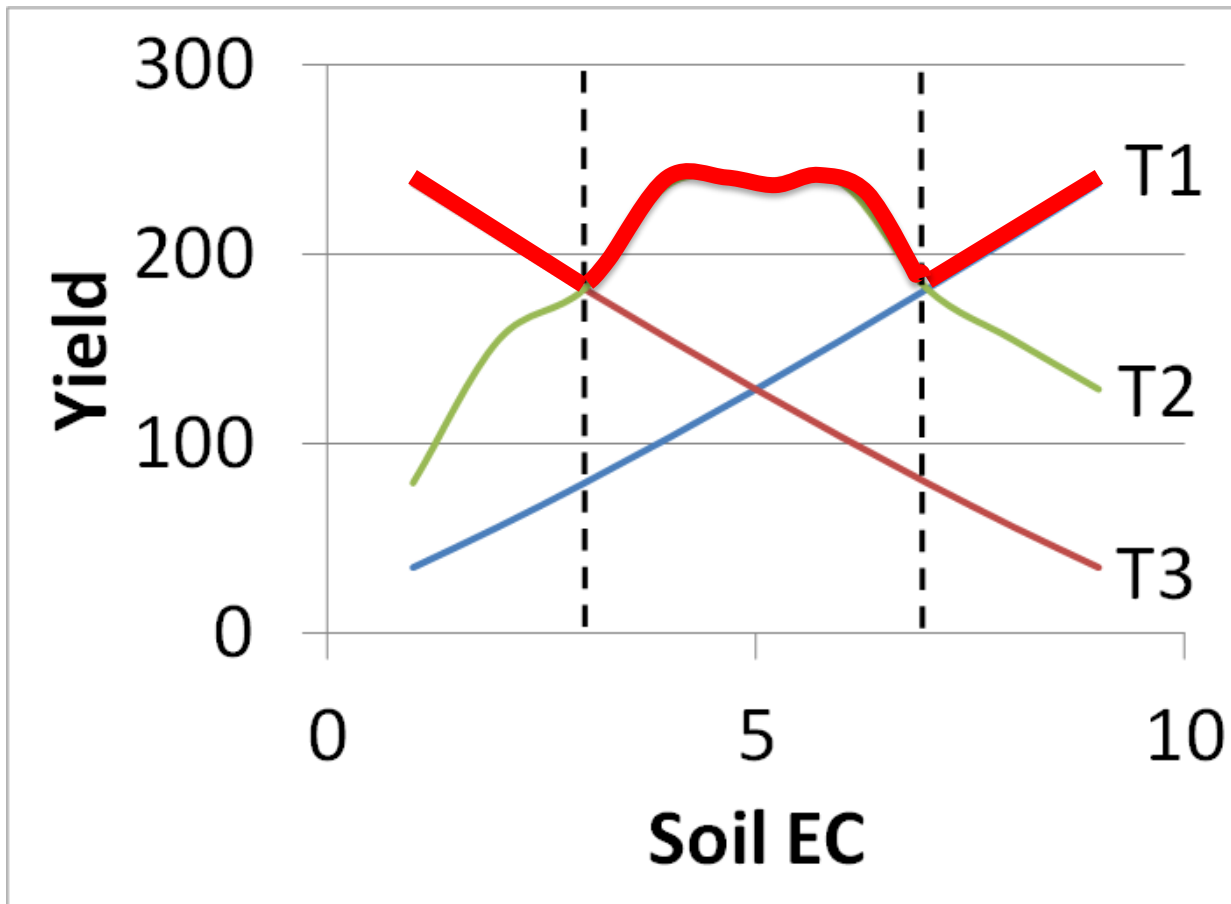


# Variable Rate Irrigation





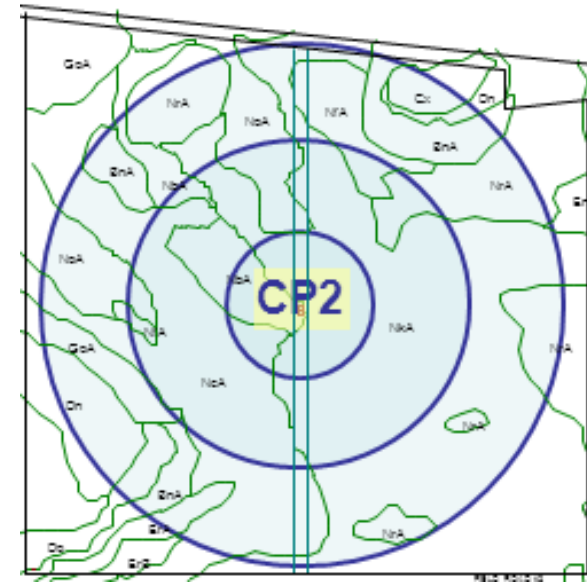
# Variable Rate Irrigation



# Irrigation Research

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- USDA-ARS ~ Florence, SC
- Corn
- Split field into 12 soil types
  - Determined WHC
  - Used ET
  - Determined water balance
- Created 1, 2, and 4 management zones



*Stone and Bauer*



# Irrigation Research

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- Concluded only 2 management zones were needed
- Considering historic weather data depending on year, dry or wet, 5-6 zones may be needed
- Irrigation water savings appears to be beneficial in highly variable soil
- Coupling NDVI with crop ET may have merit

*Stone and Bauer*



# Challenges Moving Forward

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- Ways to quickly determine variability in field need to be developed
  - How much variability is enough to justify VR
  - Yield map?
- Prescription development needs to be standardized by region
- Other technologies should be coupled with VRI technology to max profit
- Justifying additional cost of VRI



# Opportunities

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- Depending on the field water savings could be significant
- Incorporating system automation with remote sensing technologies to irrigate would be ideal
- Maximizing IWUE and profit could be obtained with VRI





# Thank you!

## Questions?

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