Soil Moisture Sensor Data Interpretation and Applications

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All About Irrigation Workshop
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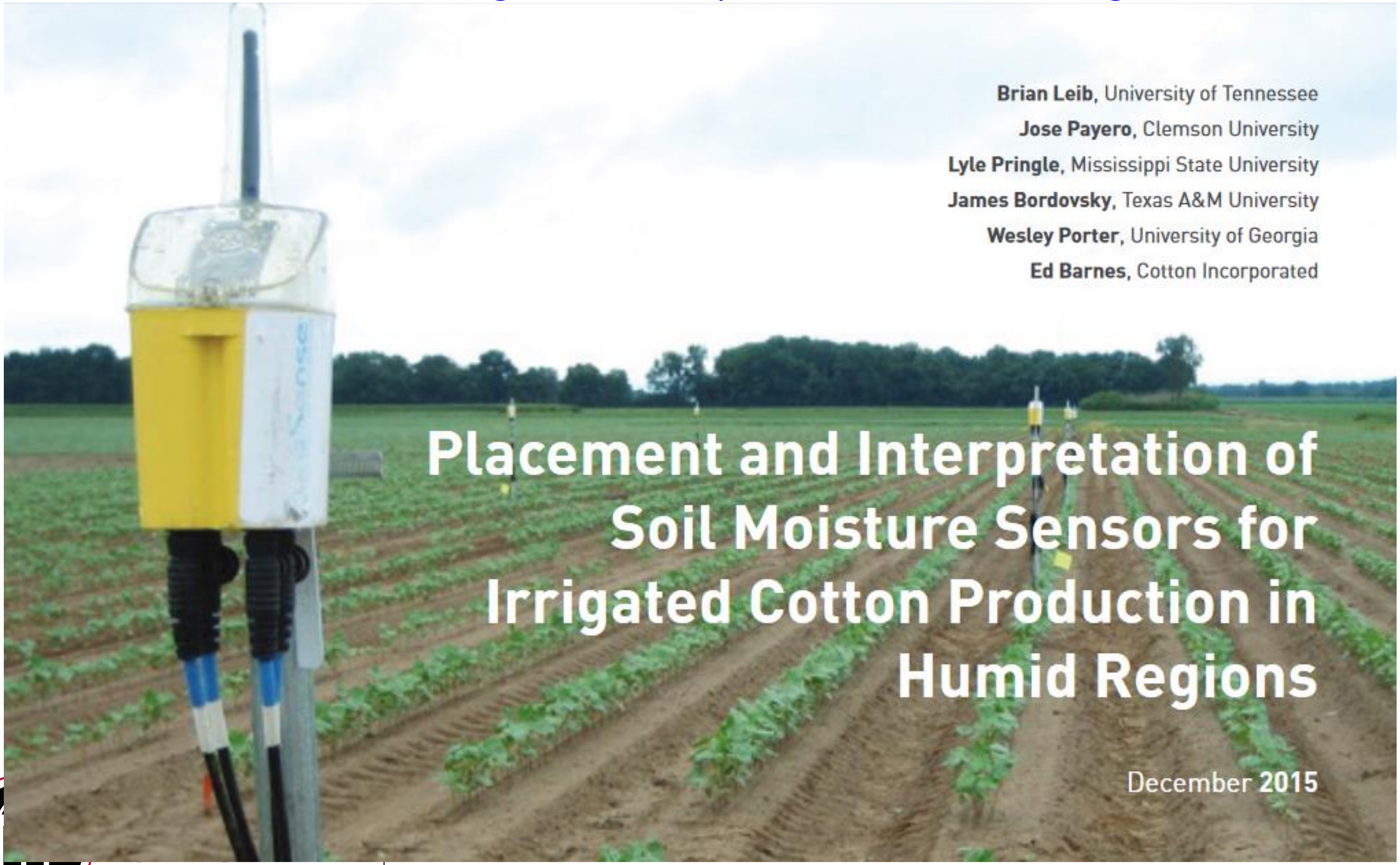
UGA extension

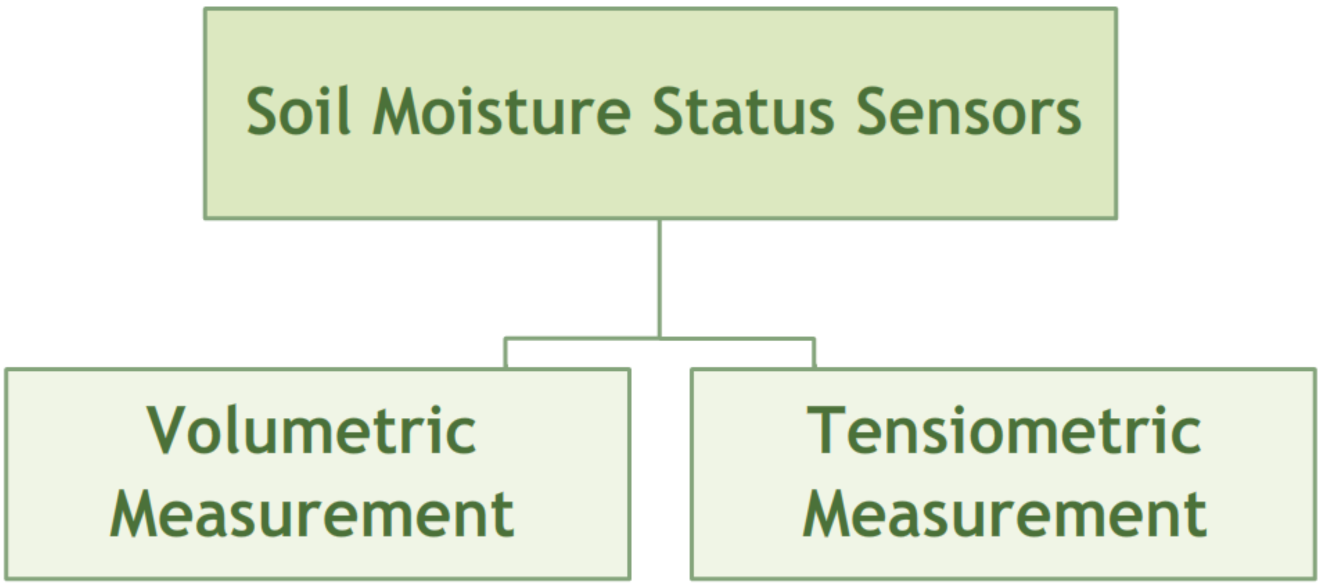
Soil Moisture Sensor Placement

https://cottoncultivated.cottoninc.com/research_reports/placement-and-interpretation-of-soil-moisture-sensors-for-irrigated-cotton-production-in-humid-regions/



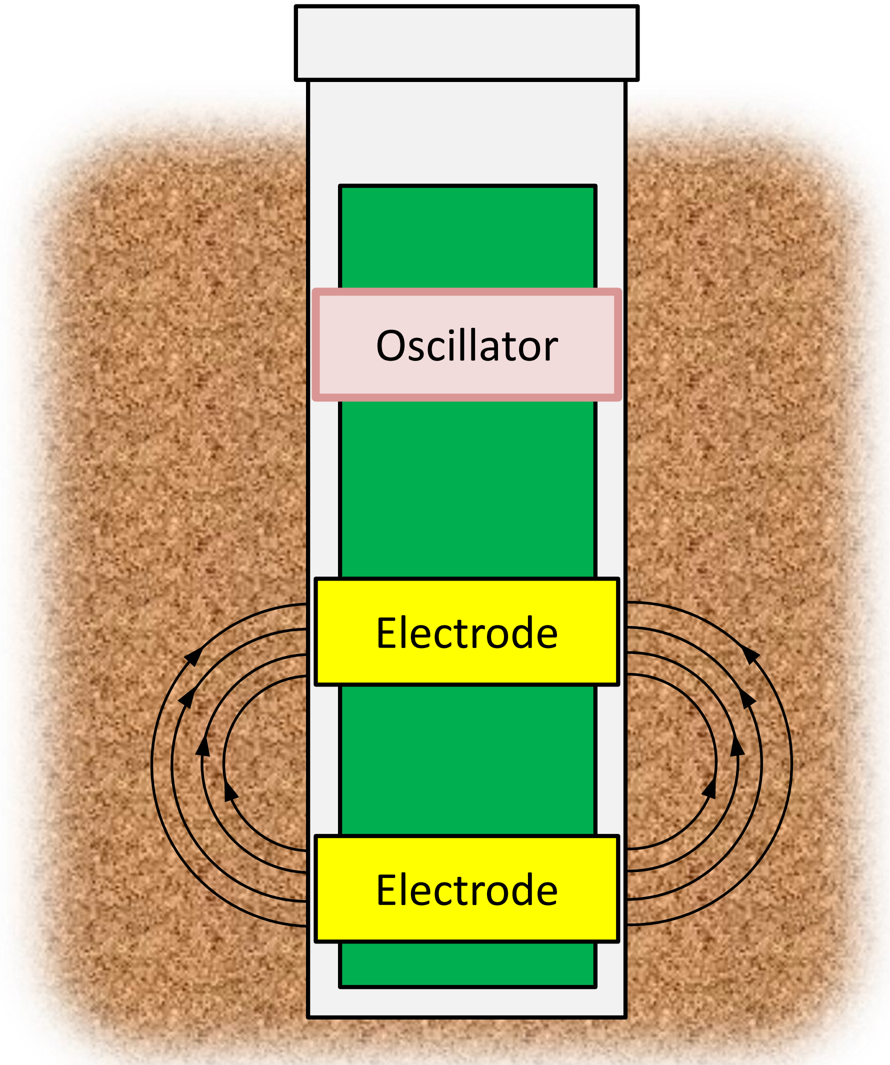
RSMM

- Remote Soil Moisture Monitoring

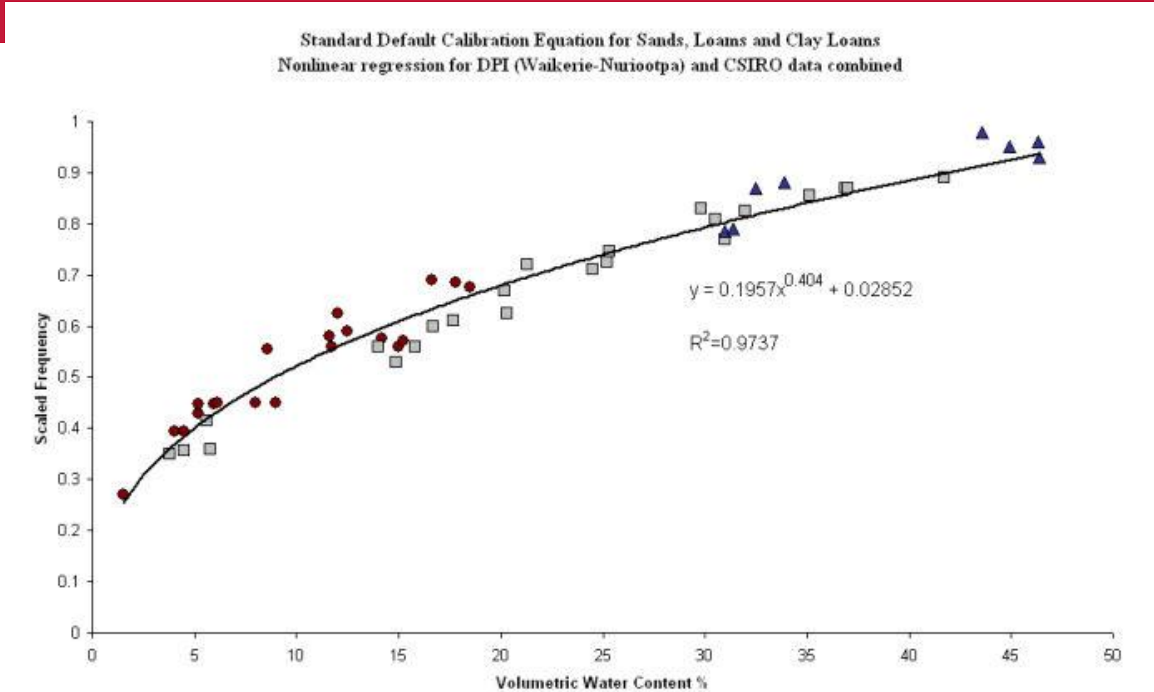


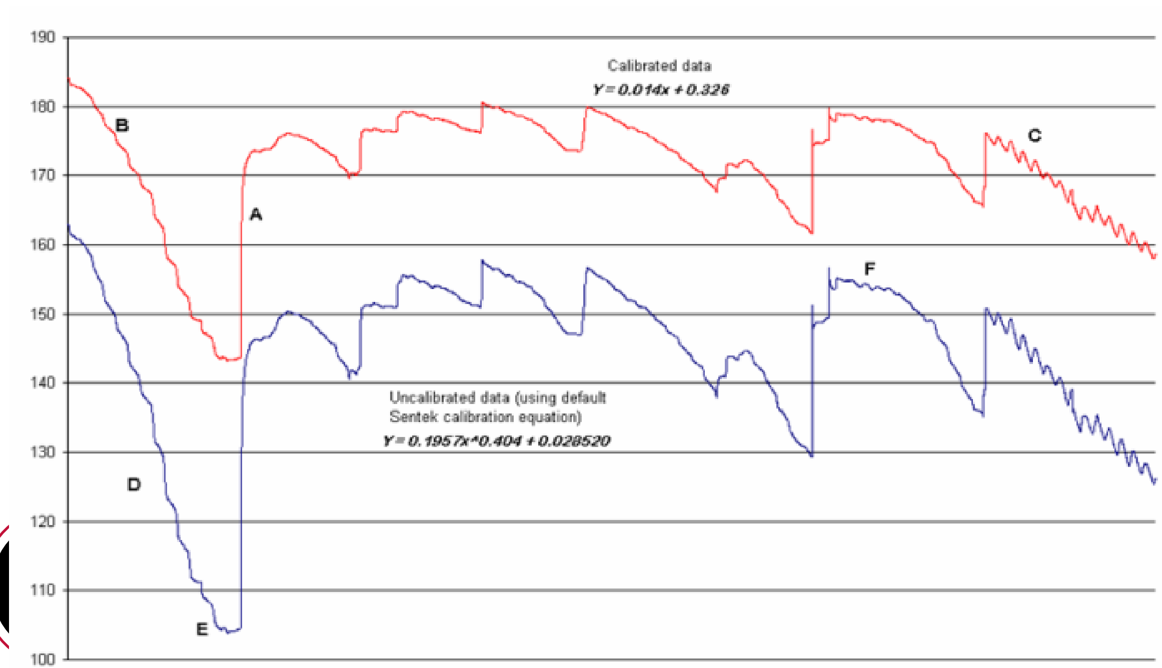
Capacitance Sensors

- Oscillator applies frequency between 50 – 150 MHz to electrodes
- Causes resonant frequency in surrounding soil
  - Frequency is function of dielectric constant
  - High soil moisture = low frequency
  - Low soil moisture = high frequency
- Calibration equation



Calibration





Proper calibration required

http://www.sentek.com.au

Capacitance Sensors

- Adcon
- AquaCheck
- Aqua Spy
- Decagon
- Dynamax
- Sentek
- Etc.

Capacitance Sensors

Advantages

- Accurate after calibration
- Respond quickly
- Wide range (wet to very dry)
- Can be used in high salinity environments
- Many choices on the market

Disadvantages

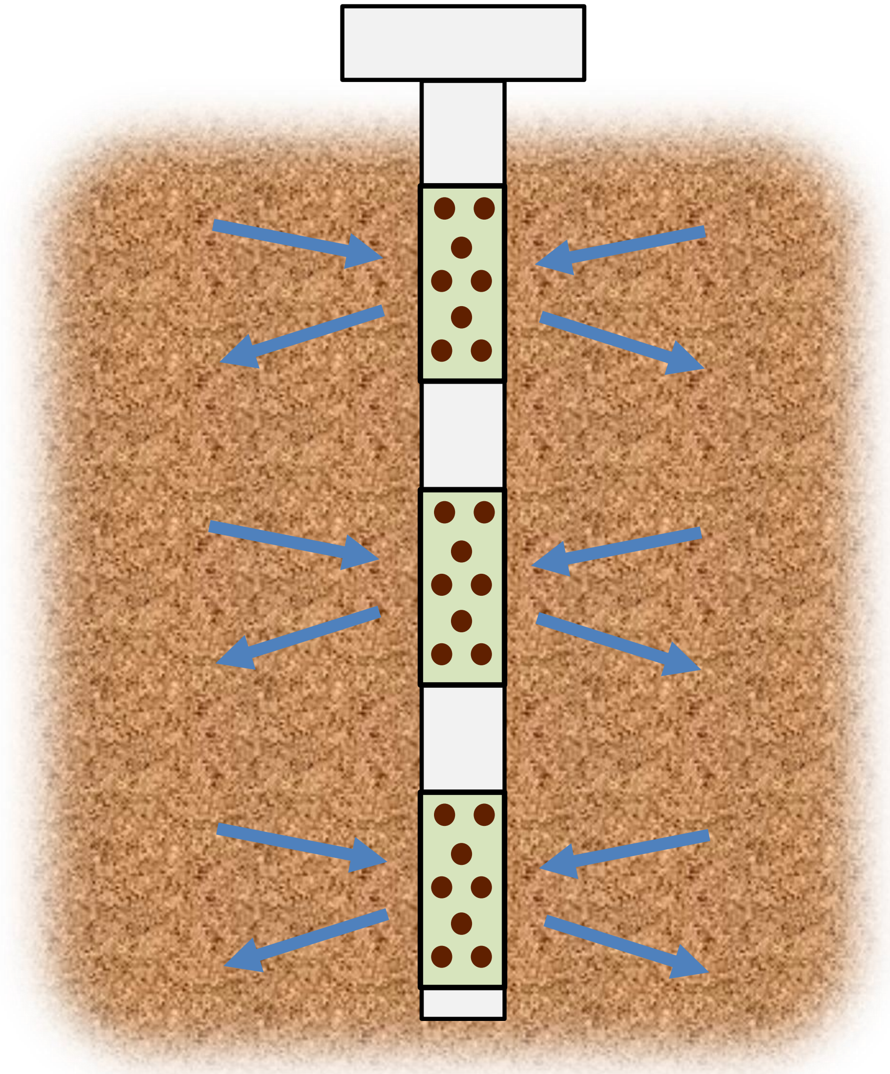
- Soil-specific calibration
- Small sensing distance (0.5 to 0.8 inches)
- Cost compared to tensiometric sensors
- Energy requirements

Tensiometer

- Plastic tube filled with water.
- Ceramic cup at bottom allows tension in water column to equilibrate with soil water tension
- Water column tension read by gage or pressure sensor
- Requires regular maintenance

Granular Matrix Sensors

- Electrodes embedded in granular matrix
- Soil water in soil equilibrates with granular matrix
- Embedded electrodes measure resistance change
  - Wet = low resistance
  - Dry = high resistance



Tensiometric Sensors

Irrometer

- Watermark
- Tensiometers

Decagon

- MPS-2 Dielectric Water Potential
- Tensiometers

Tensiometric (Granular Matrix) Sensors

<u>Advantages</u>

- Simple and inexpensive
- Up to 4 inch sensing distance
- Minimal energy requirements

<u>Disadvantages</u>

- Slower response time
  - Not a factor in irrigation scheduling for agronomic crops
- Less accurate in very wet or very dry soils
- May require temperature compensation

Data Collection – Telemetry

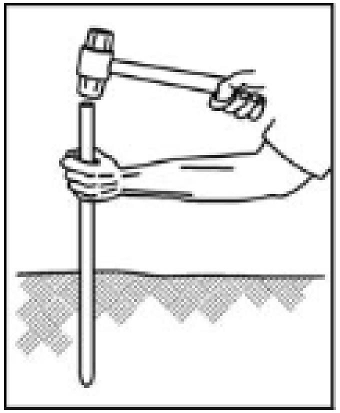
- Manual
- Bluetooth
- Radio link
- Cell modem
- Satellite uplink

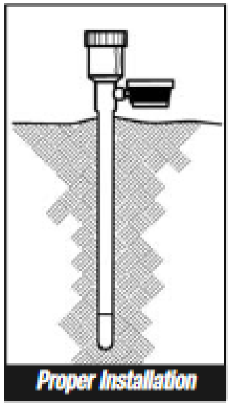
Problems with RSMM

- Interpretation of sensor data
  - Setting the correct thresholds for each crop
  - Properly weighting sensor depths correctly
- Acquisition of data
  - Manual (infrequent)
  - Telemetry (usually high cost)
- Overall System Cost
- Intensive management required
- Support of systems
  - Installations/Uninstallations
  - Data

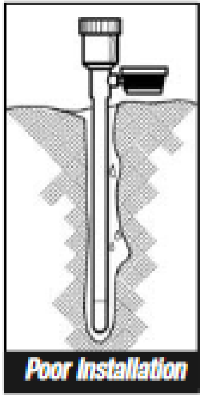
Preparation and Installation

- Tensiometers and Watermarks should be soaked in clean water for approximately 24 hours prior to installation.
- Installation can be completed by a few options:
  - Soil probe or a ½" piece of metal pipe driven into the ground to the proper depth.
  - ½" or greater diameter auger

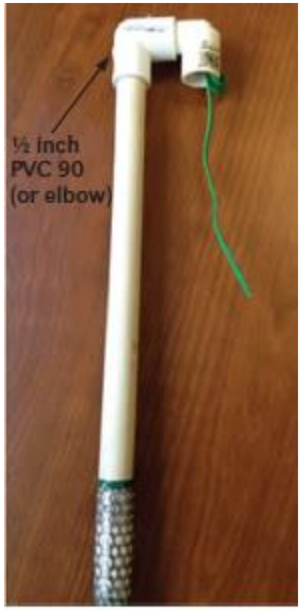




Proper Installation

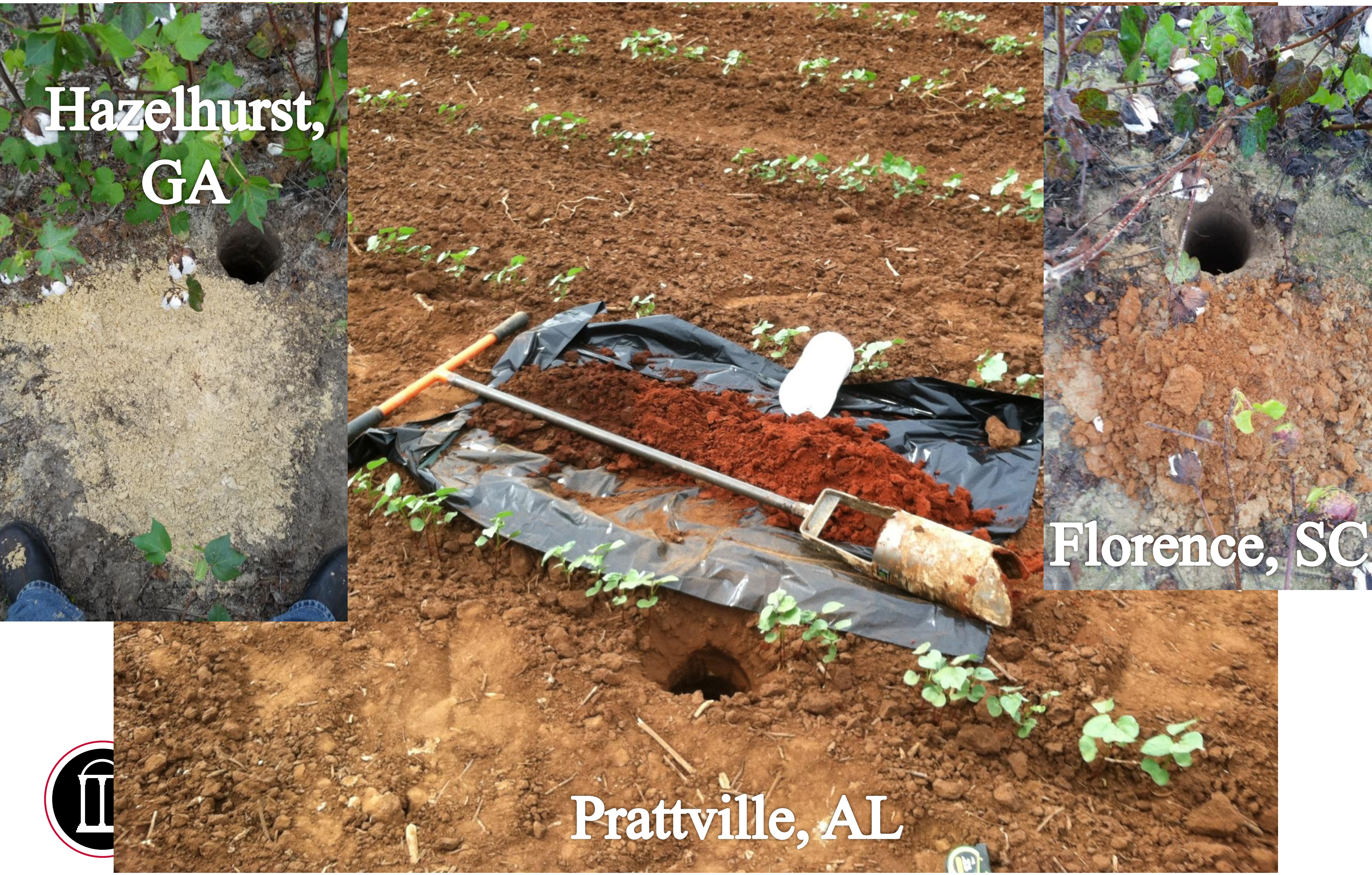


Poor Installation



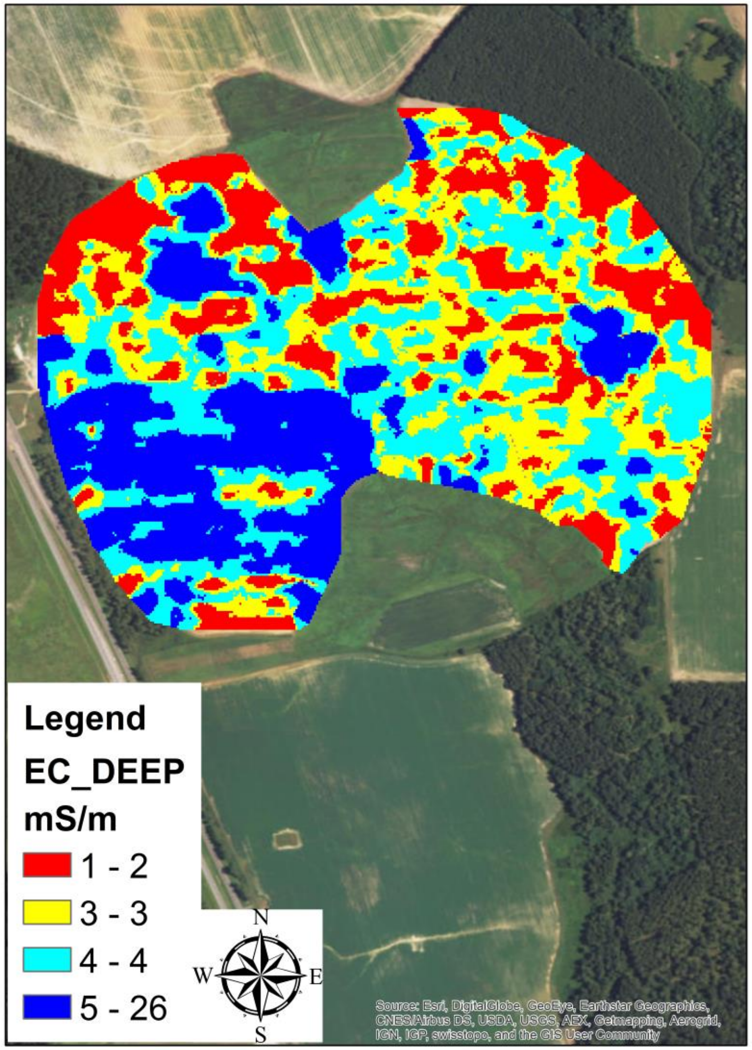
Preparation and Installation

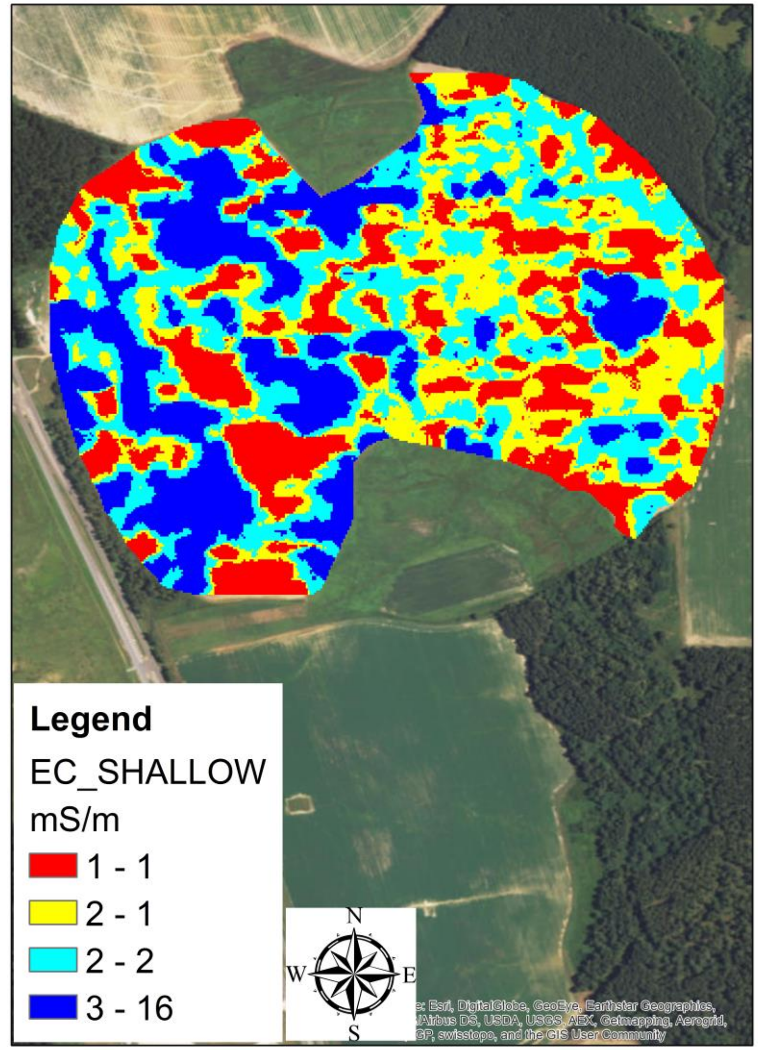
Preparation and Installation



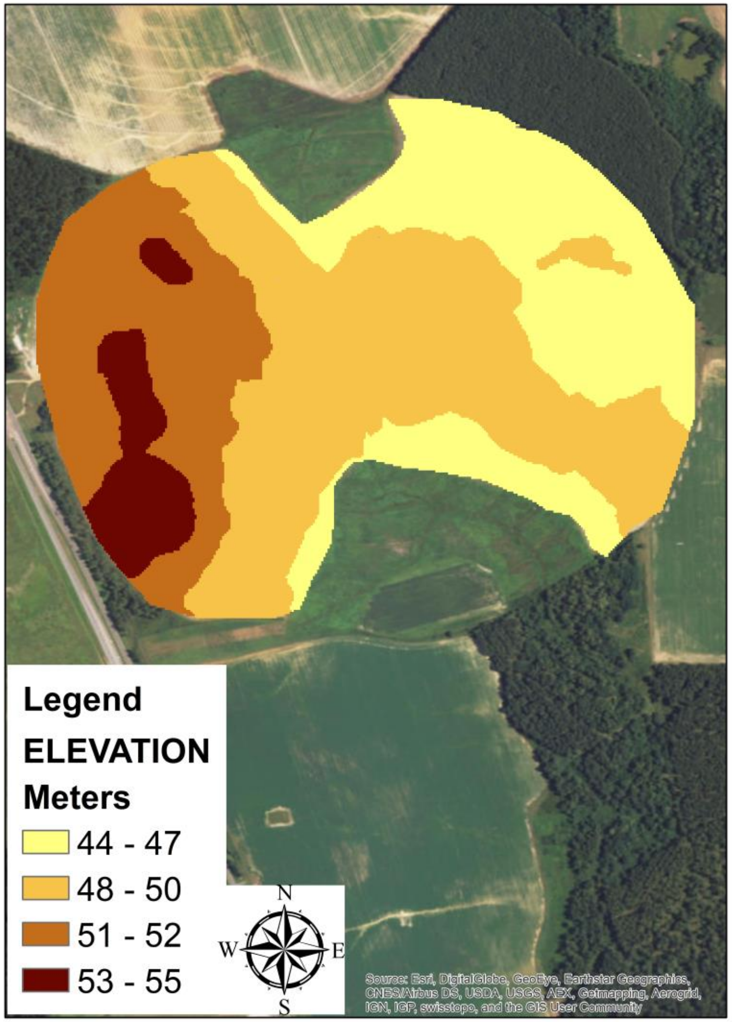

Prattville, AL
Cordele, GA
Hazlehurst, GA
Eupora, MS
Belle Mina, AL

Sensor Placement





Sensor Placement



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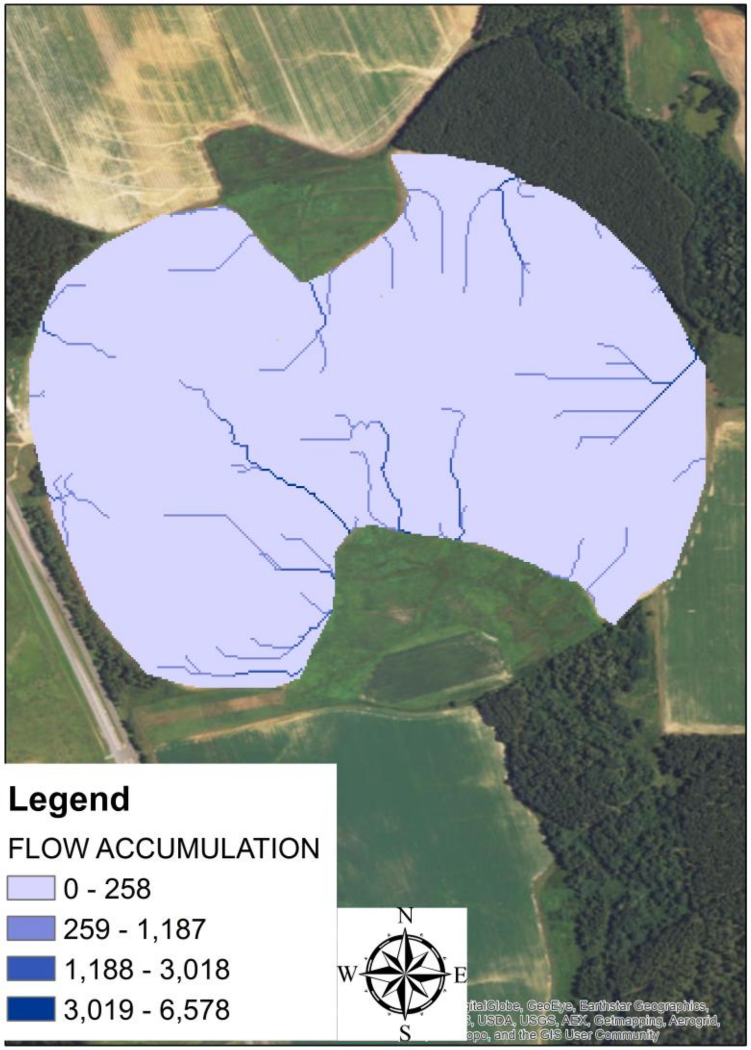

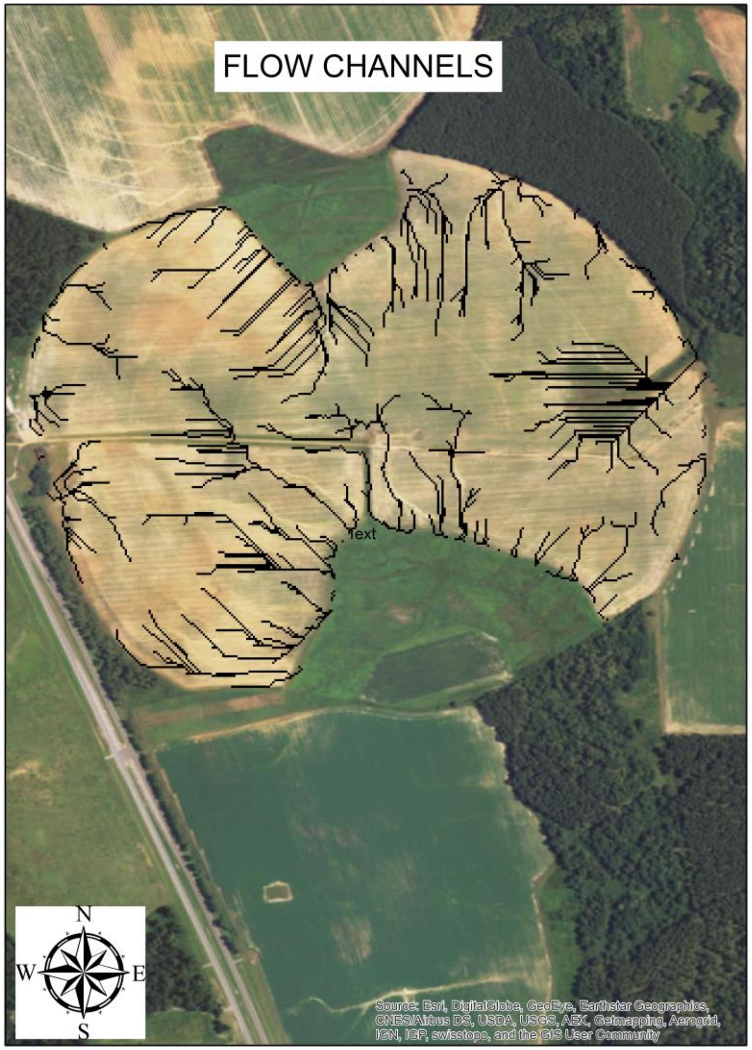

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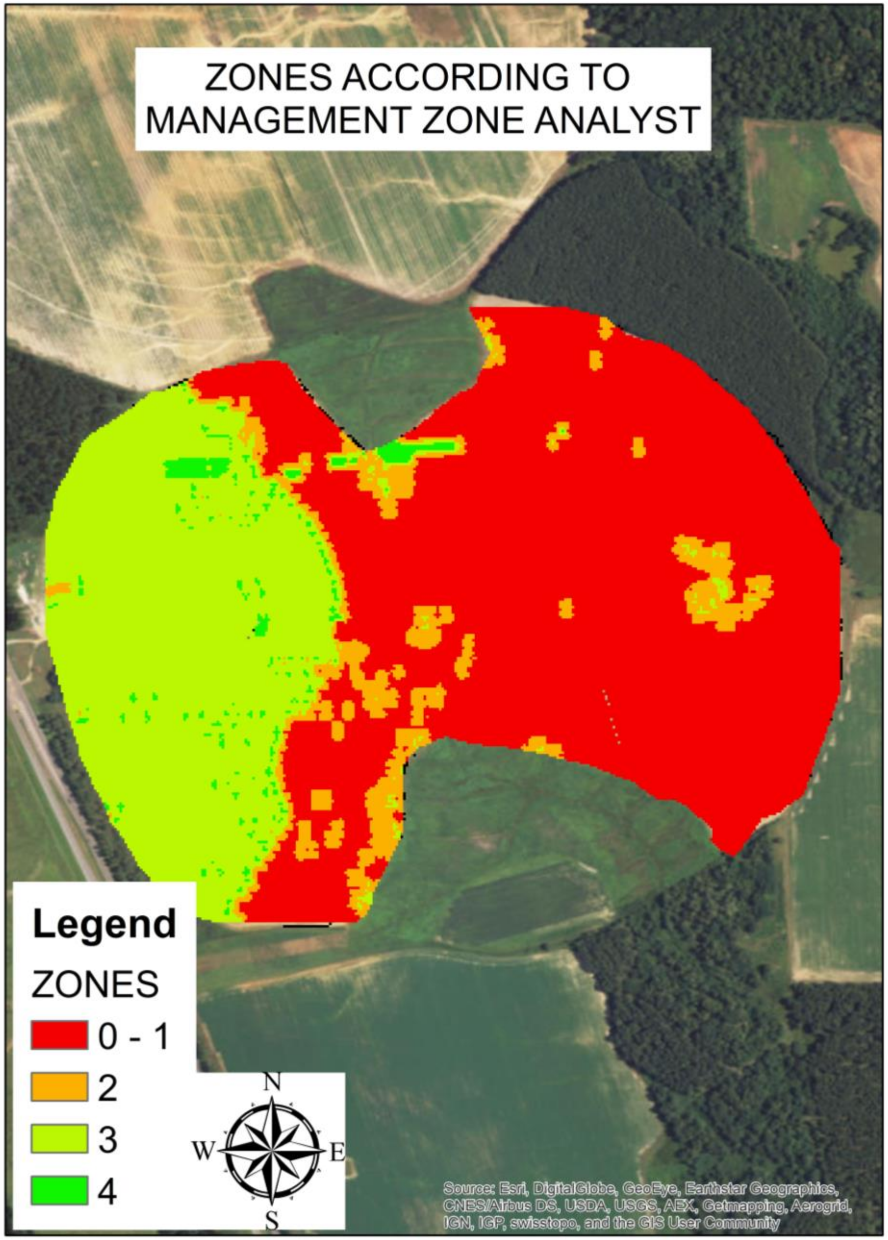

Soil Moisture Sensor Placement

- The more layers of field data that are available the better.
- Local knowledge of the field helps.
- Higher numbers of sensors and more VRI zones will require higher the level of management.
- Higher resolution on a VRI system and more sensors in the field cost more money.

What to Do With the Data

- There are a few options of how to proceed with soil moisture data (SWT data):
  - Schedule Irrigation
  - Monitor responses to irrigation and rainfall
  - Determine irrigation trigger levels
  - Variable Rate Irrigation
- How do you determine trigger levels
  - Soil type
  - Weighted Averages
  - IrrigatorPro

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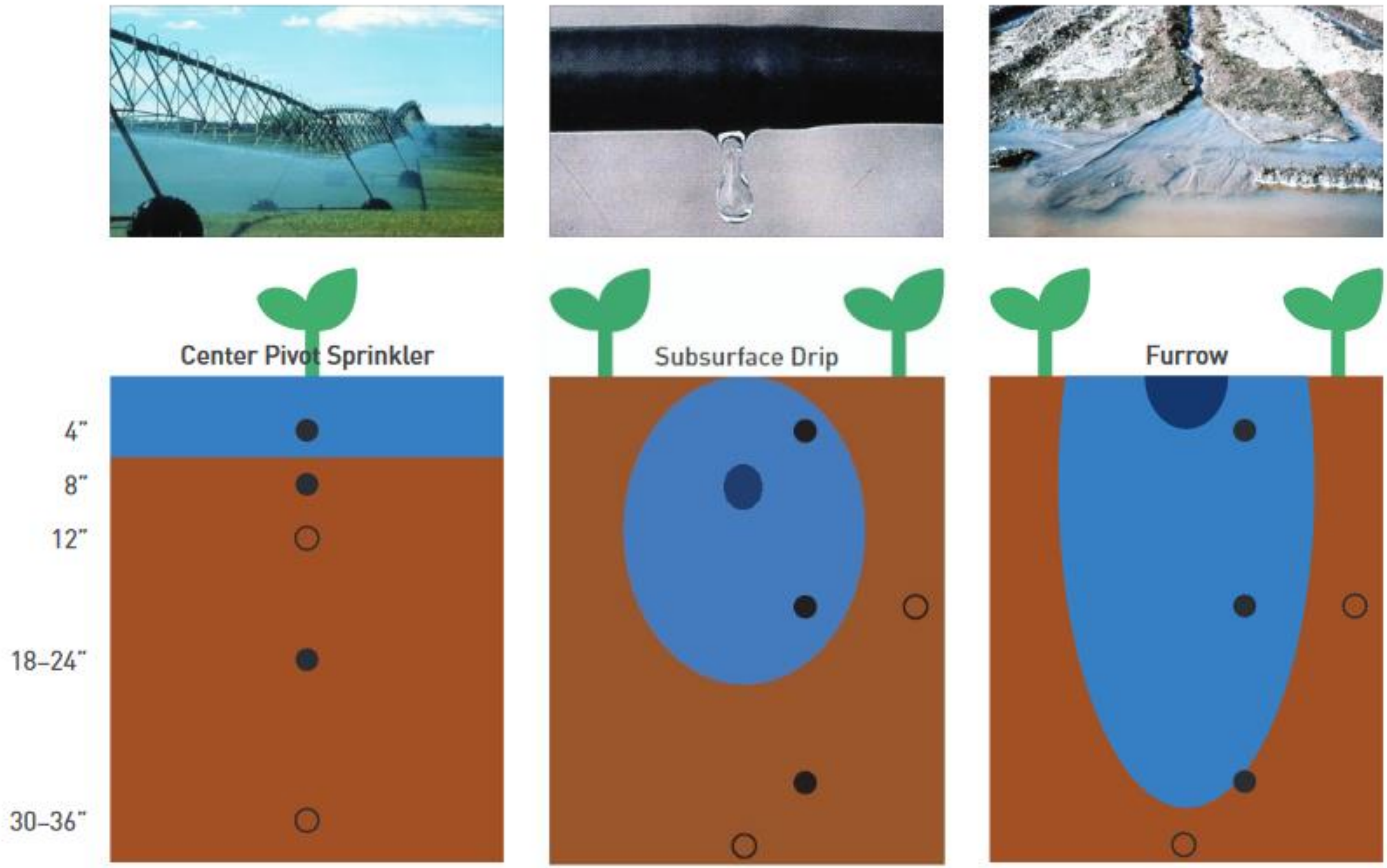


What to Do With the Data

- Weighted Averages
  - Sensor Depths
    - Crops
      - Cotton
        - » 4-6”, 8-12”, 16-24”
      - Corn
        - » 8”, 16”, 24”
      - Soybeans
        - » 6”, 12”, 18”
      - Peanuts
        - » 4”, 8”, 16”

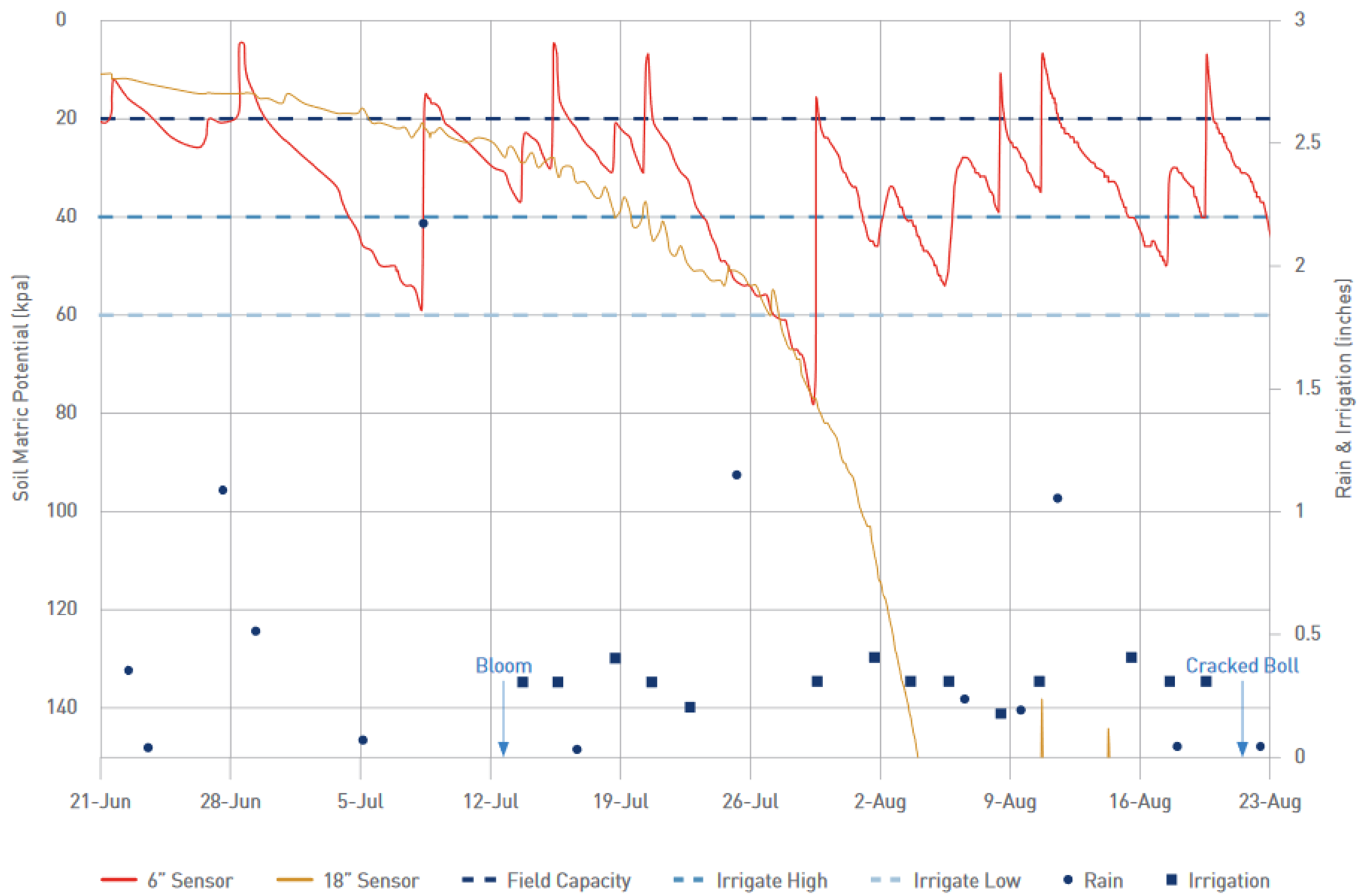
What to Do With the Data

- Weighted Averages
  - Crop maturity and root development

These are only meant as a guide, you should apply local knowledge to your specific crops.

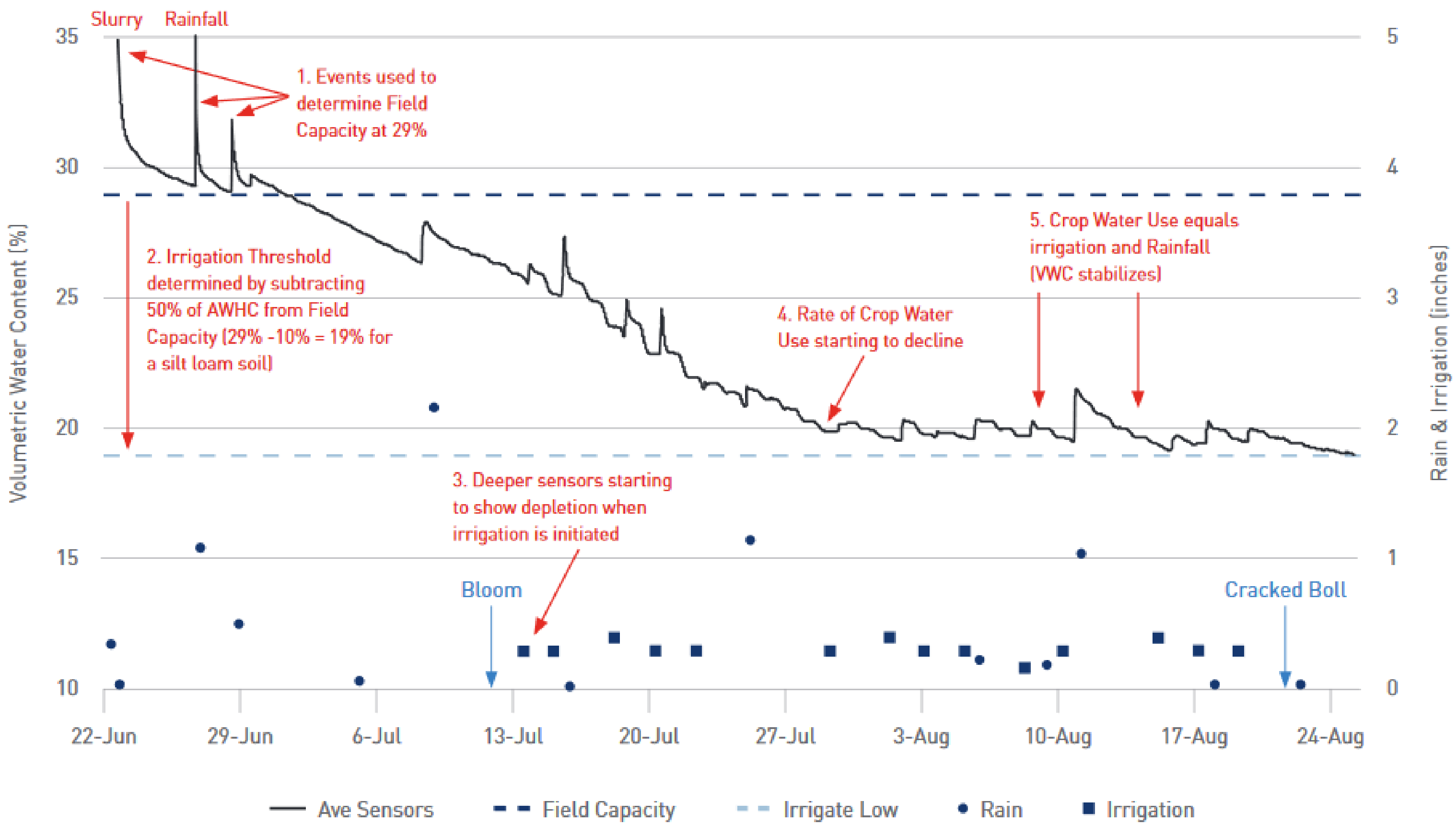
  - Late Season
    - $0.40 * D_1 + 0.30 * D_2 + 0.30 * D_3$

Soil Moisture Sensor Data Interpretation



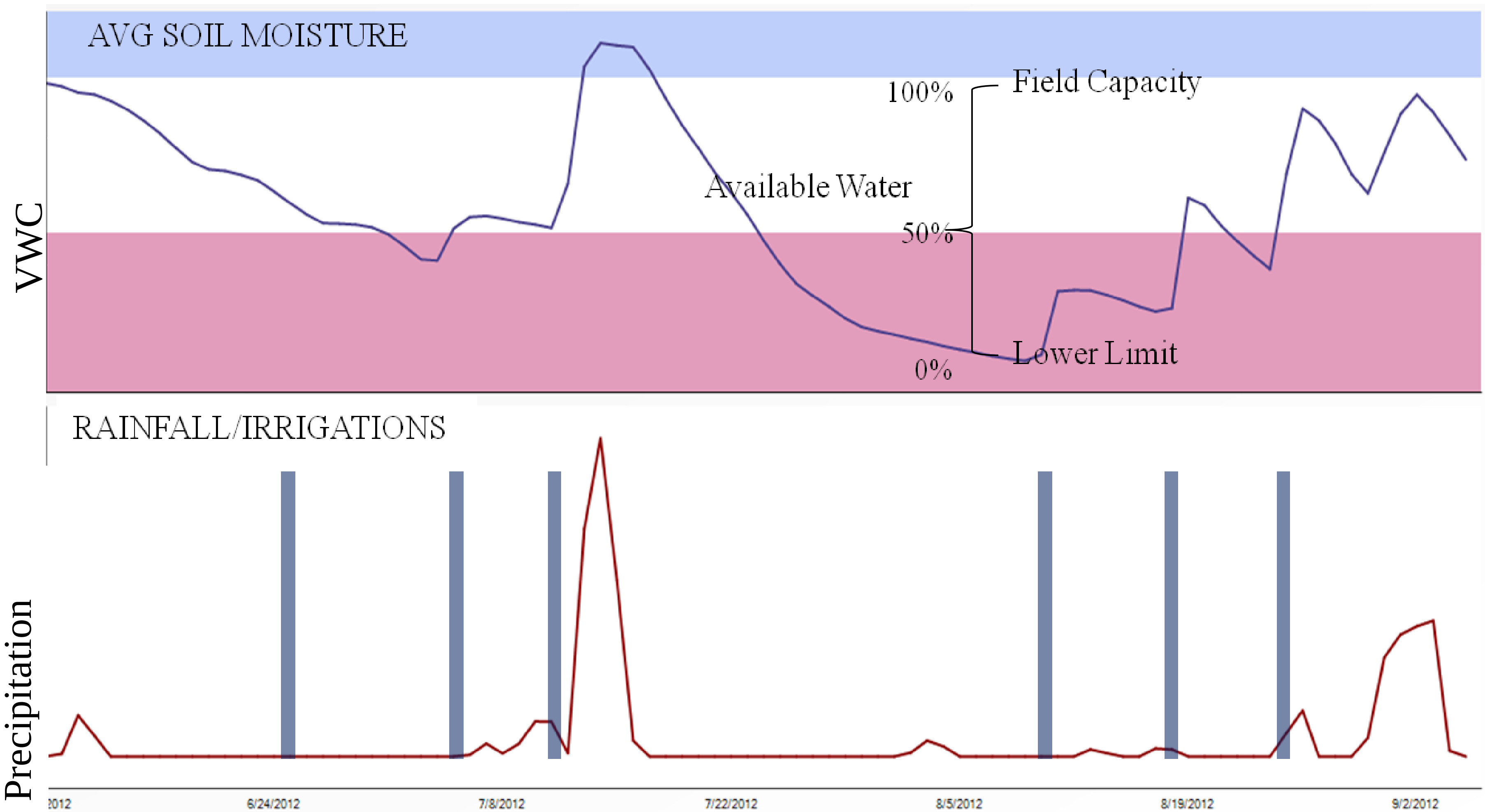
	Soil Type/Texture				
	Loamy Sand	**Sandy Loam**	**Loam**	**Silt Loam**	**Clay Loam**
Saturation (kPa or cbar)	0 to -5	0 to -5	0 to -7.5	0 to -10	0 to -10
Field Capacity (kPa or cbar)	-10	-15	-20	-20	-25
Irrigation Threshold (kPa or cbar)	-25 to -30	-30 to -40	-35 to -50	-40 to -60	-60 to -80

Soil Moisture Sensor Data Interpretation

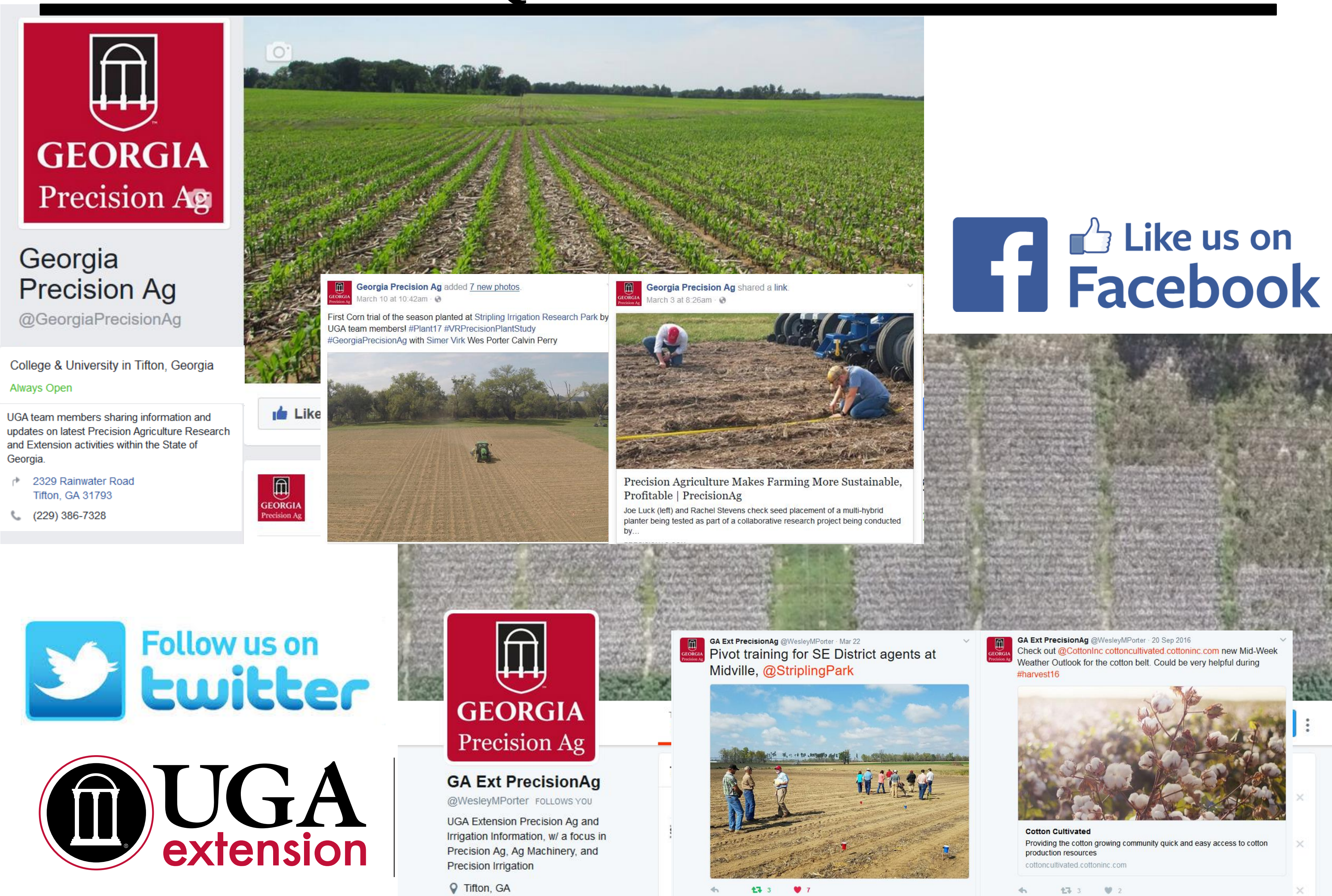


Data Interpretation

- Select upper and lower thresholds of PAW
  - Either through soil testing or in-season observations



Questions??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Like
Georgia Precision Ag added 7 new photos.
March 10 at 10:42am
First Corn trial of the season planted at Stripling Irrigation Research Park by UGA team members! #Plant17 #VRPrecisionPlantStudy #GeorgiaPrecisionAg with Simer Virk Wes Porter Calvin Perry
Georgia Precision Ag shared a link.
March 3 at 8:26am
Precision Agriculture Makes Farming More Sustainable, Profitable | PrecisionAg
Joe Luck (left) and Rachel Stevens check seed placement of a multi-hybrid planter being tested as part of a collaborative research project being conducted by...
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Check out @CottonInc cottoncultivated.cottoninc.com new Mid-Week Weather Outlook for the cotton belt. Could be very helpful during #harvest16
Cotton Cultivated
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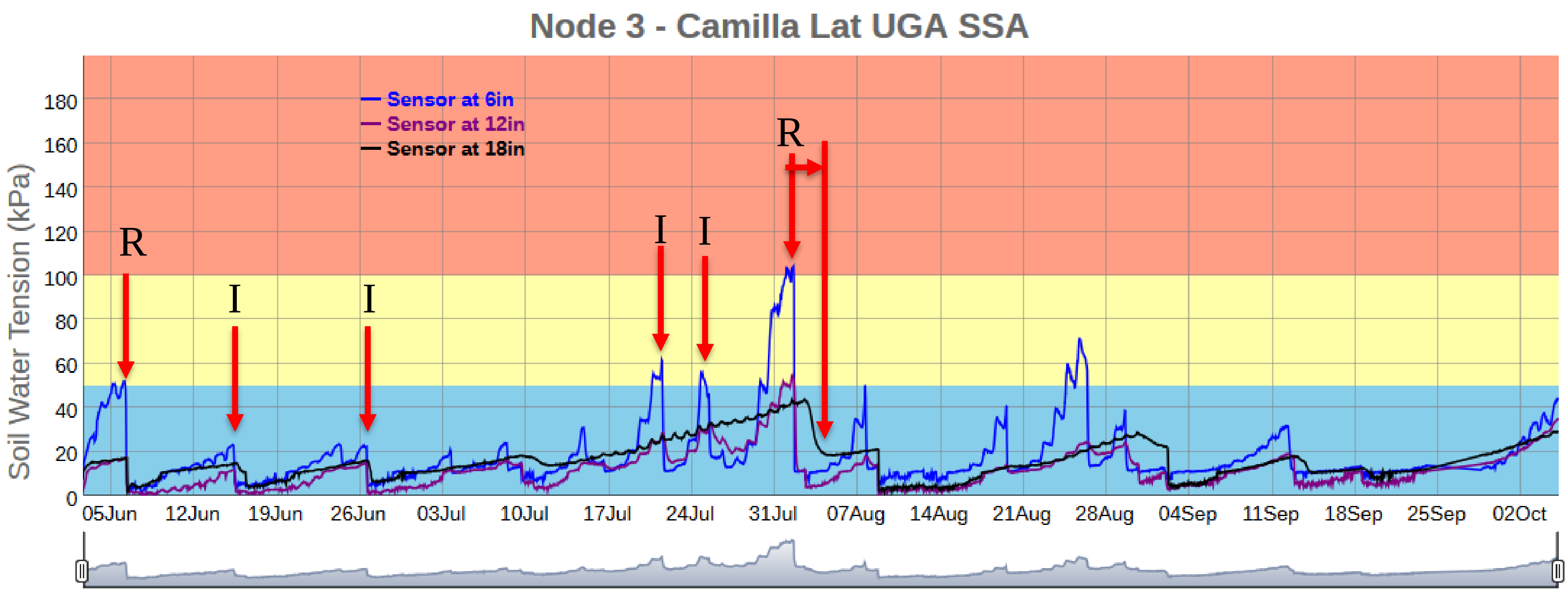
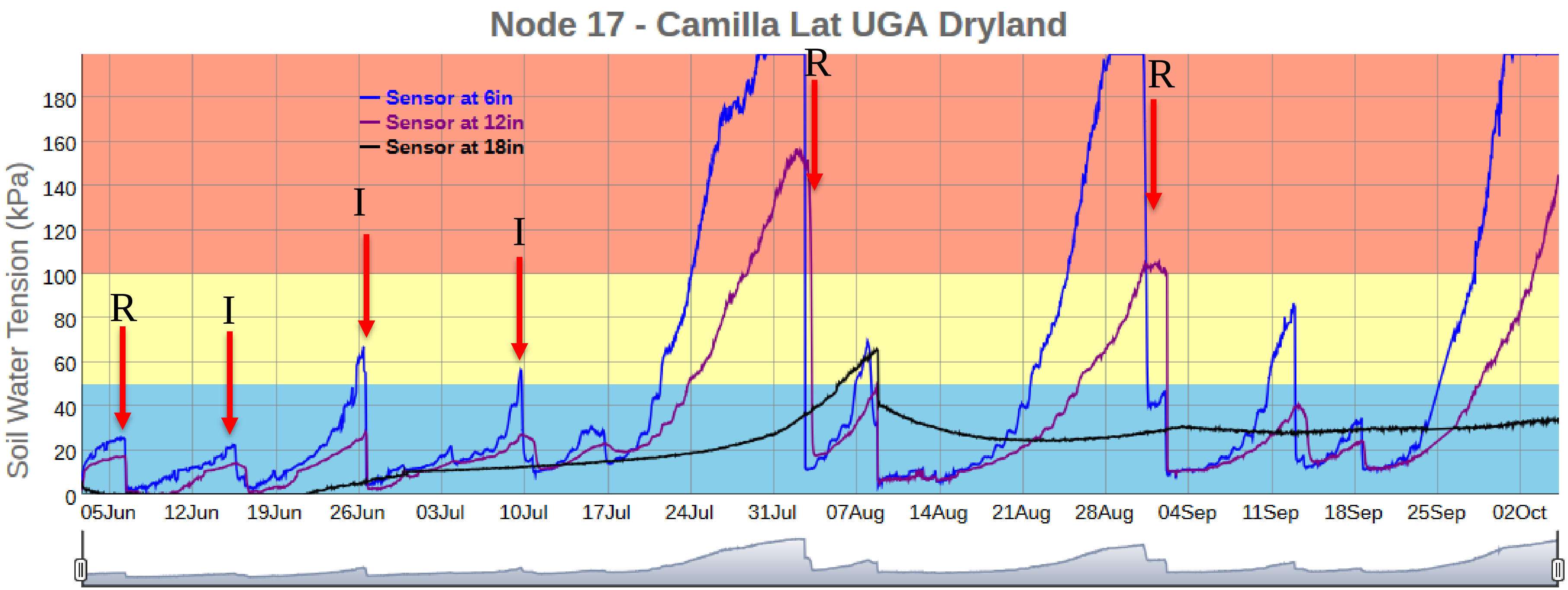
Irrigation Timing and Frequency



Irrigation (I) or Rainfall (R)

Irrigation Timing and Frequency



Irrigation (I) or Rainfall (R)

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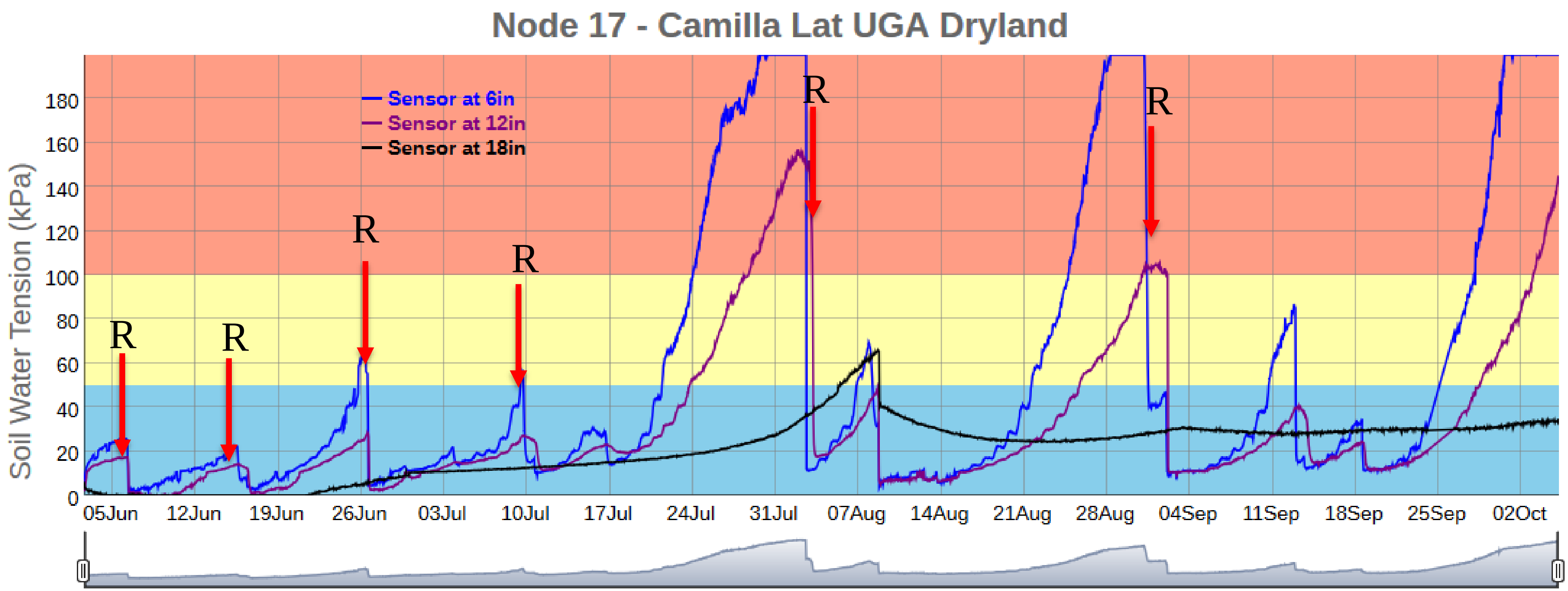

Irrigation (I) or Rainfall (R)

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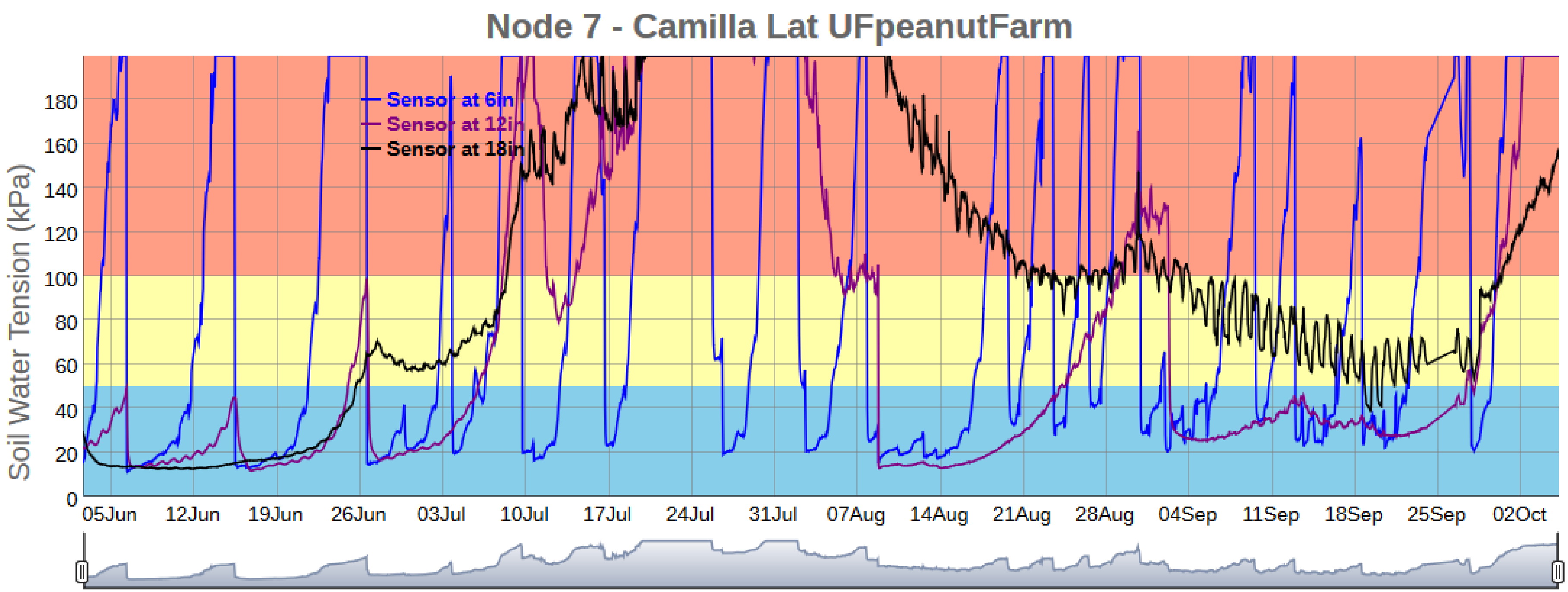
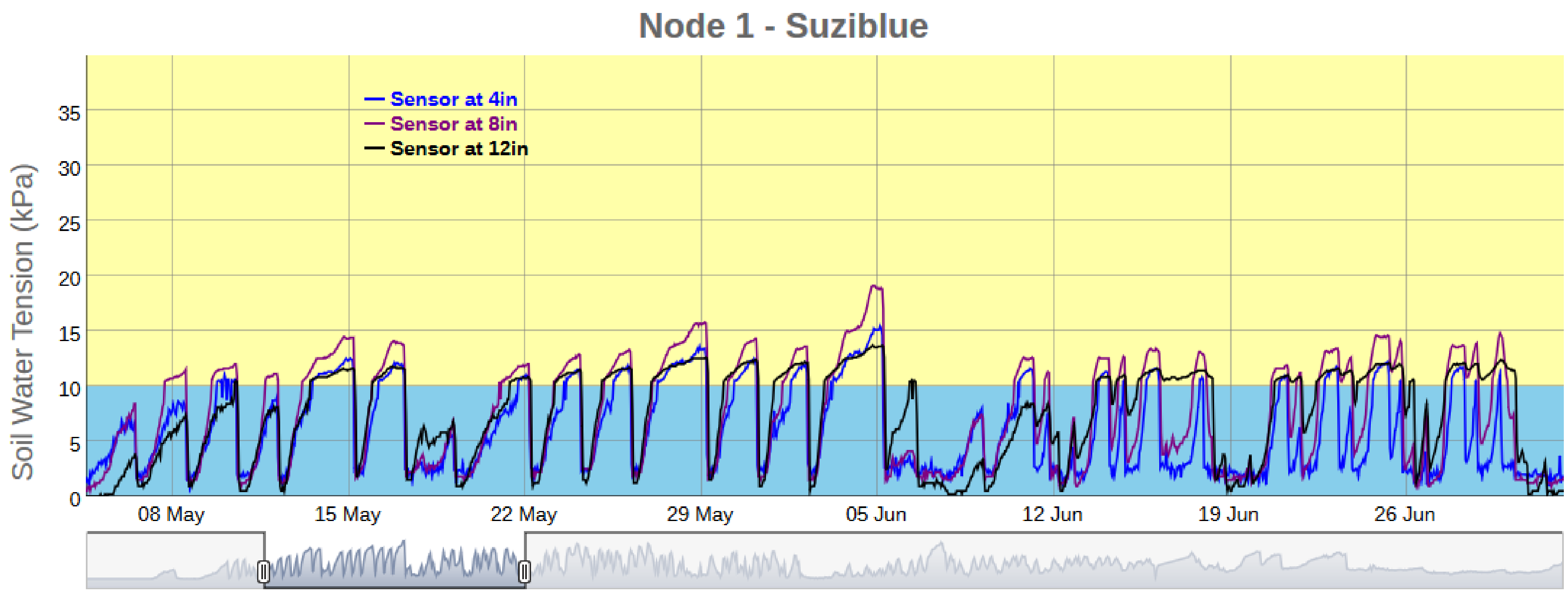


Irrigation (I) or Rainfall (R)

Sensor Based Irrigation Management



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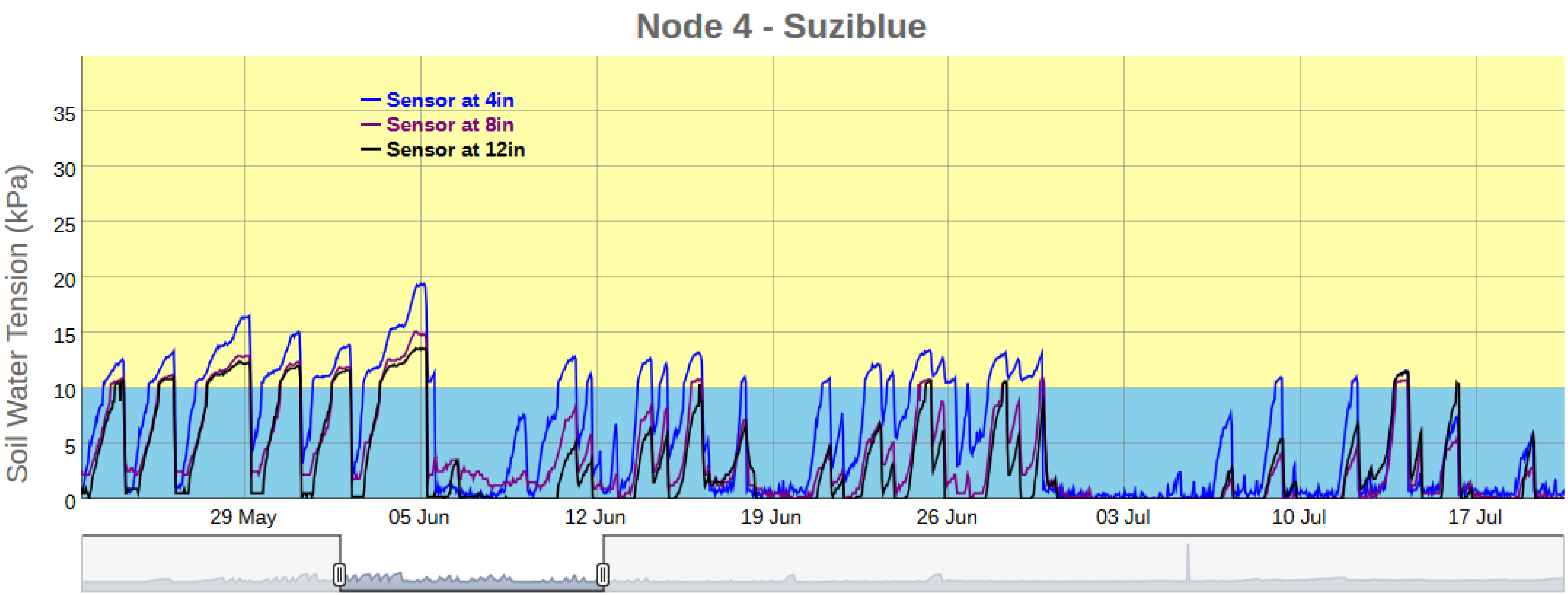

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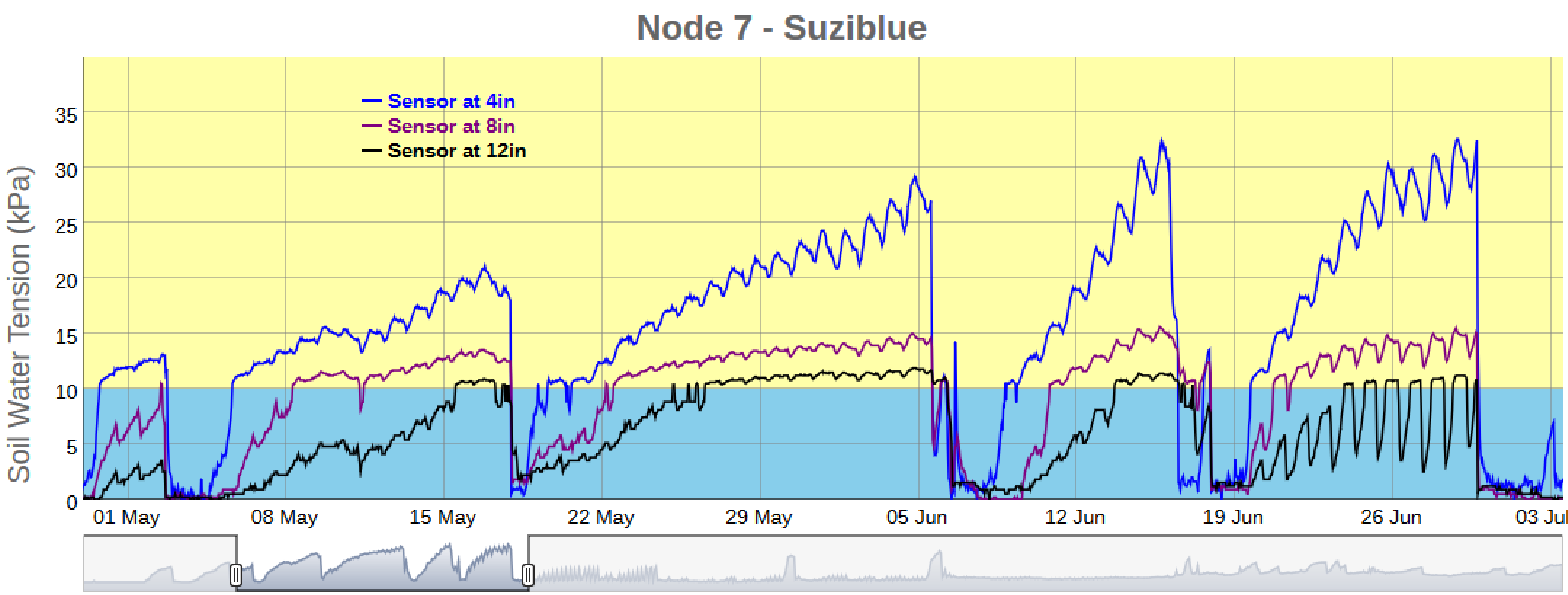

Sensor Based Irrigation Management

Was the sensor used to schedule irrigation in this case?