Lab Calibration of a Water Content Reflectometer

Erin L. Bush
Gerard J. Kluitenberg
Nathan O. Nelson

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Introduction

- Importance of accurate soil moisture measurements
  - Monitor water use by cropping systems
  - Assist with management decisions
- Kansas Agricultural Watershed Research Site
  - Smolan silty clay loam: 35% clay
  - Confirm calibration with field measurements

- Calibration necessary due to changes in soil properties
  - Texture differentiation
  - Ranges of salinity
  - Bulk density

Objective

Determine if CS655 water content reflectometers require soil-specific calibration prior to field use

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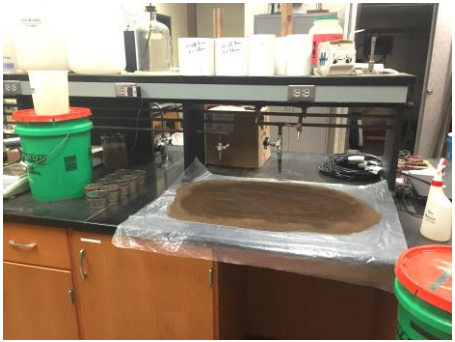
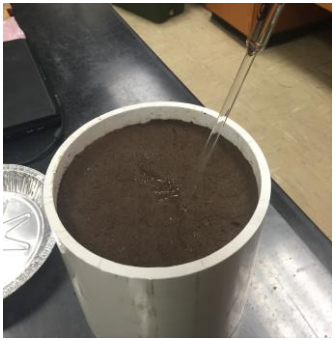
Methods



- Soil Preparation
  - Air dried, 2mm sieve
  - Gravimetric water content measured
- Wetting Process
  - Soil wetted to target gravimetric water content
  - 0.0005 M $CaSO_4$
    - Bulk EC < 0.9 ds/m
  - Water content achieved

Methods

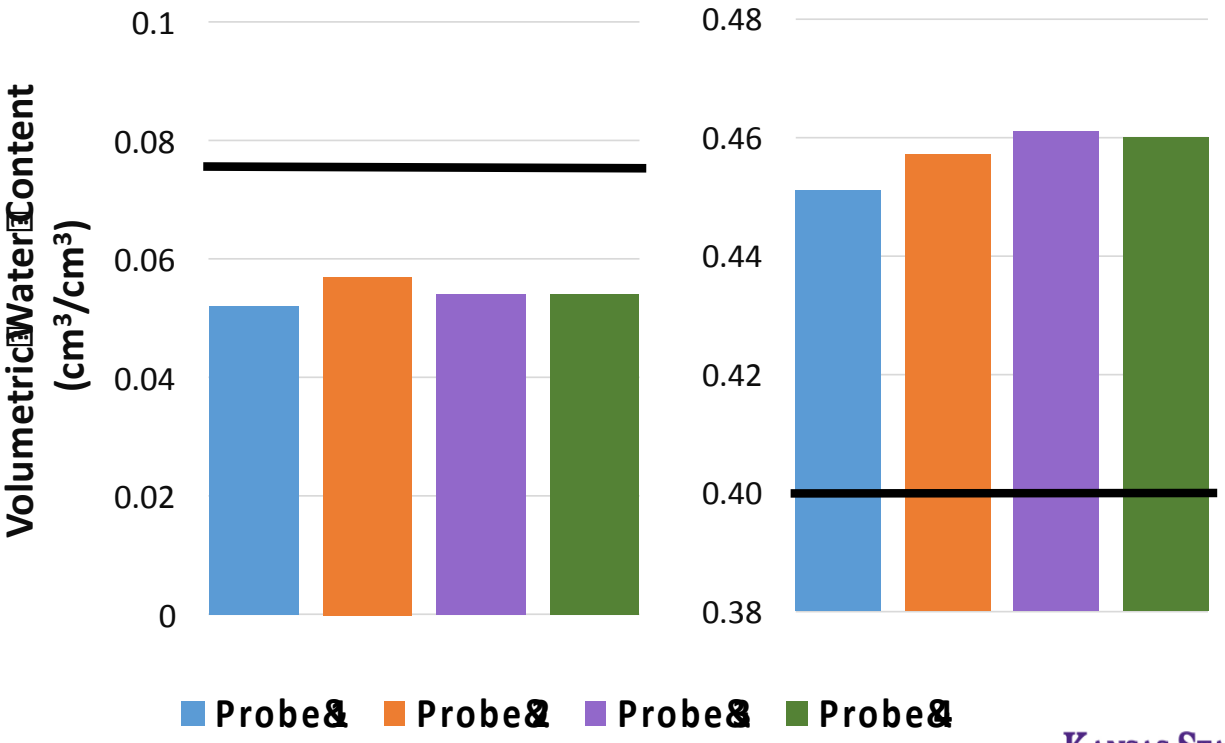
- Soil Packing
  - 4 - 20.3 cm (h) PVC columns
  - 6 layers, 3 cm each
  - Target bulk density: 1.25 g cm^{-3}
  - Porosity at target bulk density: 0.53
  - 8 water contents: 0.03-0.40 cm^3 cm^{-3}



Methods

- Taking Readings
  - 4 probes
  - One probe per column
  - Volumetric water content, EC, degrees Celsius, permittivity
  - Check permittivity
- Measured gravimetric water content

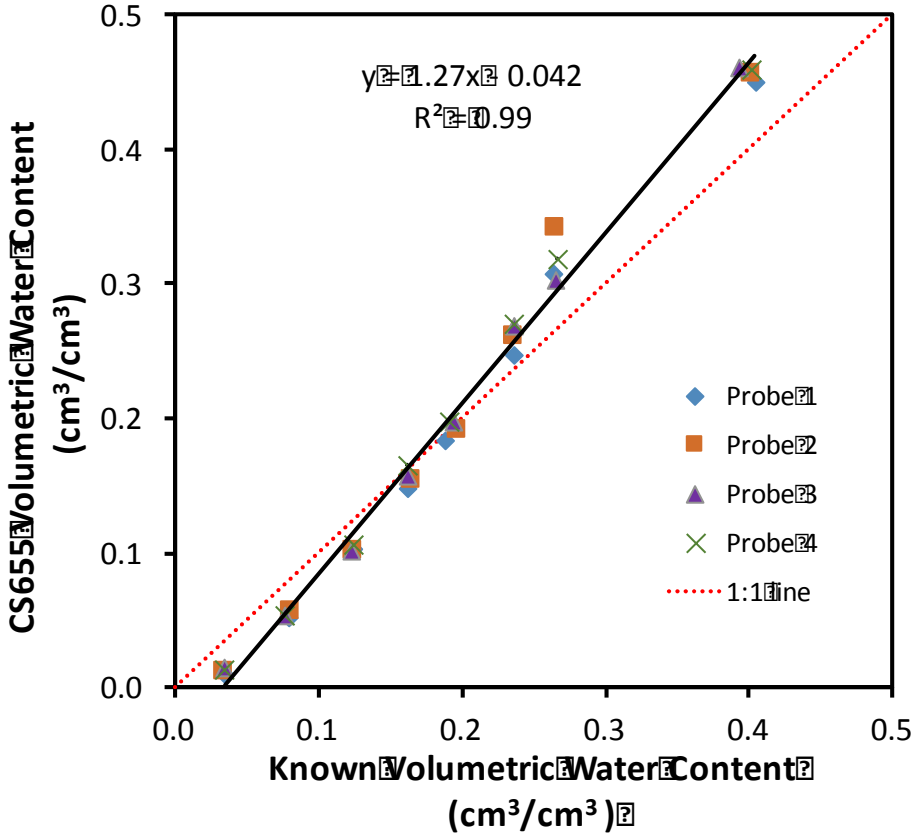
Results


Volumetric Water Content (cm³/cm³)
0.1
0.08
0.06
0.04
0.02
0
0.48
0.46
0.44
0.42
0.40
0.38
Probe 1
Probe 2
Probe 3
Probe 4

Calibration Correction

- **Linear Correction**: Volumetric water content comparison as a linear function
- **Permittivity Calibration 1**: Permittivity vs known volumetric water content as a quadratic function
- **Permittivity Calibration 2**: Known volumetric water content vs square root of permittivity

Linear Correction



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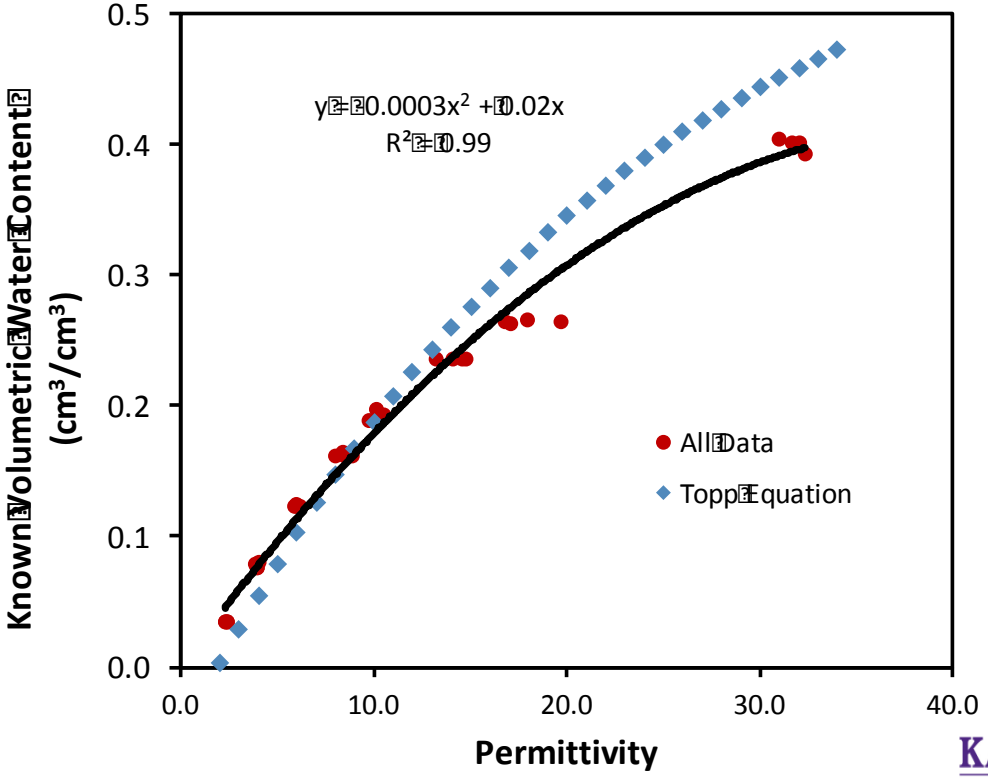
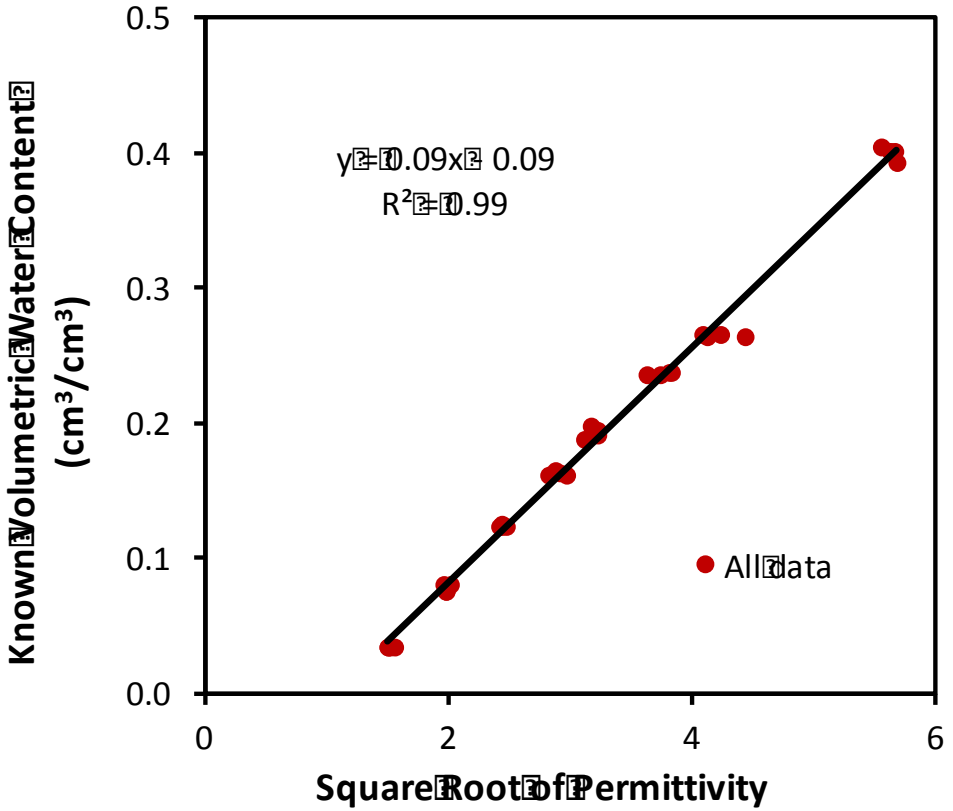
Permittivity Calibration 1



Permittivity Calibration 2



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Statistical Analysis

Root Mean Square Error	
Correction Method	**RMSE**
CS655 Topp Equation	0.0330
Linear Correction	0.0109
Volumetric Water Content vs. Permittivity Calibration	0.0224
Volumetric Water Content vs. Square Root of Permittivity Calibration	0.0081

Conclusion

- No significant differences between the probes
- Calibration necessary for accuracy:
  - - 4% to + 6%
  - Depends on soil moisture
- Future research: Evaluate effects of soil properties on calibration
  - Bulk density
  - Salinity
  - Different textures

Acknowledgements

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