The Soil Moisture Active Passive Marena Oklahoma In Situ Sensor Testbed (SMAP-MOISST): Design and Initial Results

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SMAP Marena Oklahoma In Situ Sensor Testbed

Site Design
• Four Base Installations
• Common depths of 5, 10, 20, 50, 100 cm, with some sampling at 2.5 cm with Hydra.
• Base station sensors
  o Stevens Water Hydra Probes (6)
  o Delta-T Theta Probes (5)
  o Decagon EC-TM probes (5)
  o Sentek EnviroSMART Capacitance Probes (4)
  o Campbell CS615/CS616 TDRs (5)
  o CS 229-L heat dissipation sensors (OK Mesonet) (5)
  o Acclima Sensor (5)

<table>
<thead>
<tr>
<th>Site A</th>
<th>Site B</th>
<th>Site C</th>
<th>Site D</th>
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<tbody>
<tr>
<td>Base</td>
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<tr>
<td>GPS</td>
<td>ASSH</td>
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<td>COSMOS</td>
<td>Passive DTS</td>
<td>CRN</td>
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<tr>
<td>TDR systems</td>
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<tr>
<td>Flux System</td>
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</table>
- Installation in May 2010
• Monthly Sampling
  o Vegetation Collection
  o Gravimetric Sampling
  o Theta Probe Sampling

• Intensive Observations
  o High Density Sampling
  o Soil Profiles
Project Planning begins October 2009

Installation and deployments

- Base Stations installed May 2010
- GPS installed in June 2010
- COSMOS installed July 2010
- Passive DTS installed October 2011
- SMAPVEX11, June 2011, PALS flights/COSMOS rover.
- Flux Tower installed October 2011
- Burn Study Winter 2012
- Additional UAVSAR flights October 2012
- AirMoss Validation October 2012
<table>
<thead>
<tr>
<th>Sensor</th>
<th>Factory Listed Accuracy</th>
<th>Bias w/ factory calibration</th>
<th>RMSE factory calibration</th>
<th>RMSE soil specific calibration</th>
<th>Failure Rate over 3 years</th>
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Comparison of the three CRN 5 cm installations which are in close proximity

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SMAP Marena Oklahoma In Situ Sensor Testbed
CRN Hydras at 100 cm depth
SMAP Marena Oklahoma In Situ Sensor Testbed
Sites A-D Hydras at 5 cm depth
SMAP Marena Oklahoma In Situ Sensor Testbed
CDFs of Site Averages by Sensor at 5 cm
SMAP Marena Oklahoma In Situ Sensor Testbed
CDFs of Site Averages by Sensor at 50 cm
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Sensor to Sensor Average Comparison

CS616 vs. Hydra

[Graph showing comparison between CS616 and Hydra]
Hydra vs. Sentek at 10 cm
### SMAP Marena Oklahoma In Situ Sensor Testbed
#### Sensor to Sensor Average Comparison

<table>
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<tr>
<th>Sensor</th>
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<th>10 cm</th>
<th>Variable Depth</th>
<th>2.5 cm</th>
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Some Conclusions

• Installation practices and procedures should be standardized

• Calibration is critical for all sensors.

• Scaling (representativeness) also critical for all sensors.

• Raingage records are important for erroneous readings and troubleshooting.

• Accuracies of < 0.04 m$^3$/m$^3$ are achievable with a variety of sensors to field scales.

• Mixing of sensors within or between domains will cause variation at the fringes of the moisture conditions.
Install/Replace Acclima sensors

Install Campbell Scientific CS655/625

Perform temperature tests for Hydra sensors

Perform a study on portable soil moisture sensors

Continue with AIRMOSS cooperation
HAPPY BIRTHDAY
SMAP Marena Oklahoma In Situ Sensor Testbed
Variability at the Surface 0-5 cm

*BEAREX08 Transect Data
Cosh et al., 2012