THE LAUNCH OF COCORAHS
SOIL MOISTURE

Peter Goble
Colorado Climate Center
2011 Texas and Oklahoma drought sparks interest in National Soil Moisture Network. Citizen Science identified as a desired component of the network.

2012 flash drought insights further interest in soil moisture projects.

Spring 2014-2016: CoCoRaHS partners with NIDIS to research logistics of a CoCoRaHS soil moisture project.

Summer 2016: Drafted protocol reviewed and field tested.

Fall 2016: Protocol revised/simplified (if you can believe it).

Spring 2017: CoCoRaHS soil moisture launched.

CoCoRaHS Soil Moisture Timeline
Soil type is assessed using a Master Gardner field guide.

Samples are taken using a rigid brass ring of ~250 cubic cm volume.

Rocks and roots removed measured with a graduated cylinder.

Samples oven dried.

Mass loss measured with CoCoRaHS scale.
A Protocol Heavily Inspired by GLOBE

- Observers will report surface samples in a GLOBE SMAP block pattern.
- Samples may deviate where terrain is rough.

![Soil Surface GLOBE SMAP Block Pattern](image)

(Drawing Not to Scale)
Observers have the option to take cores at 7-9” as well.

Soil samples from the root zone are more invasive, so samples are further apart.

The 7-9” range was chosen to conform to USDA standards of 2, 4, 8, 20, and 40” measurements.
Chief Goals of CoCoRaHS Soil Moisture

1. Usefulness as a calibration-validation tool for in-situ sensors, satellites (NASA SMAP), and numerical models
2. Usefulness as a drought monitoring tool for the National Drought Mitigation Center
3. Climate and Hydrology education
Drought hit the US hard in the summer of 2012. This was a flash drought, meaning conditions became severe quickly. Soil moisture monitoring was identified as a weak point in our drought early warning system.
Soil Moisture as an Early Warning Tool

- The atmosphere is chaotic; this makes seasonal forecasting difficult. Soil moisture data is less temporally chaotic, and may offer a partial solution.
- If root zone soils are drier (wetter) than usual, it may cause increased subsequent seasonal dryness (wetness) on a seasonal timescale (a positive feedback!)
CoCoRaHS’ Roll in the Grand Scheme

- Gravimetric Soil Moisture Measurements
- In-Situ Electronic Measurements
- Satellite Observations
- Numerical Land Surface Models

- Improved drought monitoring and early warning
- Better seasonal weather forecasts
- Bolstered understanding of climate change and variability
- More highly resolved moisture fields leading to better operational and severe weather forecasts
- Improved prediction of surface fluxes
- More accurate flood and water supply forecasts
CoCoRaHS Participation Benefits

- Education (understanding differences between precipitation and infiltration, and differences between ET and PET)
- CoCoRaHS closing the hydrologic cycle
- Citizen scientist data may be used to supplement existing satellite and in-situ data when/where gaps exist
1. Date picker
2. Time picker
3. Comments
4. Sample spacing
5. Irrigation (Y/N)
6. New Row (Y/N)
7. Soil Type
8. Wet Weight
9. Volume Removed
10. Dry Weight

<table>
<thead>
<tr>
<th>Depth</th>
<th>Soil Type</th>
<th>Weight Before Drying (grams)</th>
<th>Volume of Rocks and Roots Removed (cm³)</th>
<th>Weight After Drying (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2&quot;</td>
<td>Sandy Clay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-9&quot;</td>
<td>Sandy Clay Loam</td>
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### Soil Moisture Report

<table>
<thead>
<tr>
<th>Depth</th>
<th>Pre-Dry Weight (g)</th>
<th>Dry Weight (g)</th>
<th>Volume Removed (cm^3)</th>
<th>Dry Density (g/cm^3)</th>
<th>Volumetric Water Content(%)</th>
<th>Soil Type</th>
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<tr>
<td>0-2&quot;</td>
<td>456</td>
<td>404</td>
<td>2.0</td>
<td>1.61</td>
<td>20.80</td>
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<tr>
<td>7-9&quot;</td>
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</tbody>
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Notes

Station Number: NM-SF-70
Station Name: Santa Fe 10.5 S
Submitted: 5/13/2017 11:24 AM
Is Sample Part Of New Row: False
Observation Date: 5/2/2017
Observation Time: 4:30 PM
Is Soil Irrigated: False
Meters From Previous Sample: 0
33 volunteers have shared their interest with Nolan.

Samples promised from diverse climate regions and soil types.
14 new volunteers signed up so far in 2017

Awaiting responses from 5 interested observers

With some additional recruiting energy, we would hope to double or triple this number
1. Land that is spaced appropriately far from trees and buildings
2. Land that is available for an invasive measurement protocol
3. Observers who don’t mind baking dirt
4. Labor-intensive compared to rain gauge measurements

Conclusion: This is not for everyone!
Our short goal: 50+ regular volunteers
Long goal: 200+
Recruitment Concepts

- This project may be well-suited to partner with 4H. As a land grant university, we can use our ties with extension.
- Soil moisture protocol may lend itself well to school projects, particularly in rural areas.
- Rural observers in areas with extensive dry land Ag are highly-desired participants. CoCoRaHS soil moisture should be promoted at farm shows.
- Observers who signed up through Master Gardner can be targeted.
Updated protocol including photo documentation, and clarification of a few sticking points (ie what the heck is a bucket scoop?)

- CoCoRaHS Soil Moisture mapping
- CoCoRaHS Soil Moisture training animation
- Possibly soil moisture timeseries
Keep an eye out for observers who like to go above and beyond, or have a special passion for the water cycle.

Remember CoCoRaHS soil moisture when doing Ag-related outreach such as participation at farm shows.

Keep the recruiting and retaining the precipitation volunteers!

If you have questions, or an observer has questions, feel free to send them my way! peter@cocorahs.org