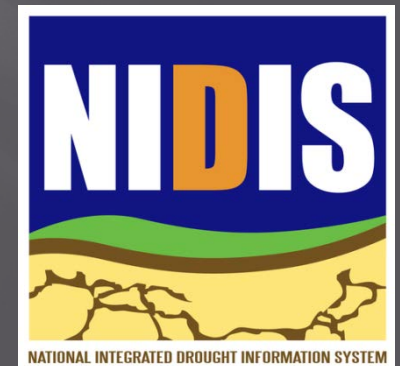


# THE LAUNCH OF COCORAHS SOIL MOISTURE

Peter Goble  
Colorado Climate Center



# CoCoRaHS Soil Moisture Timeline

- ▣ 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

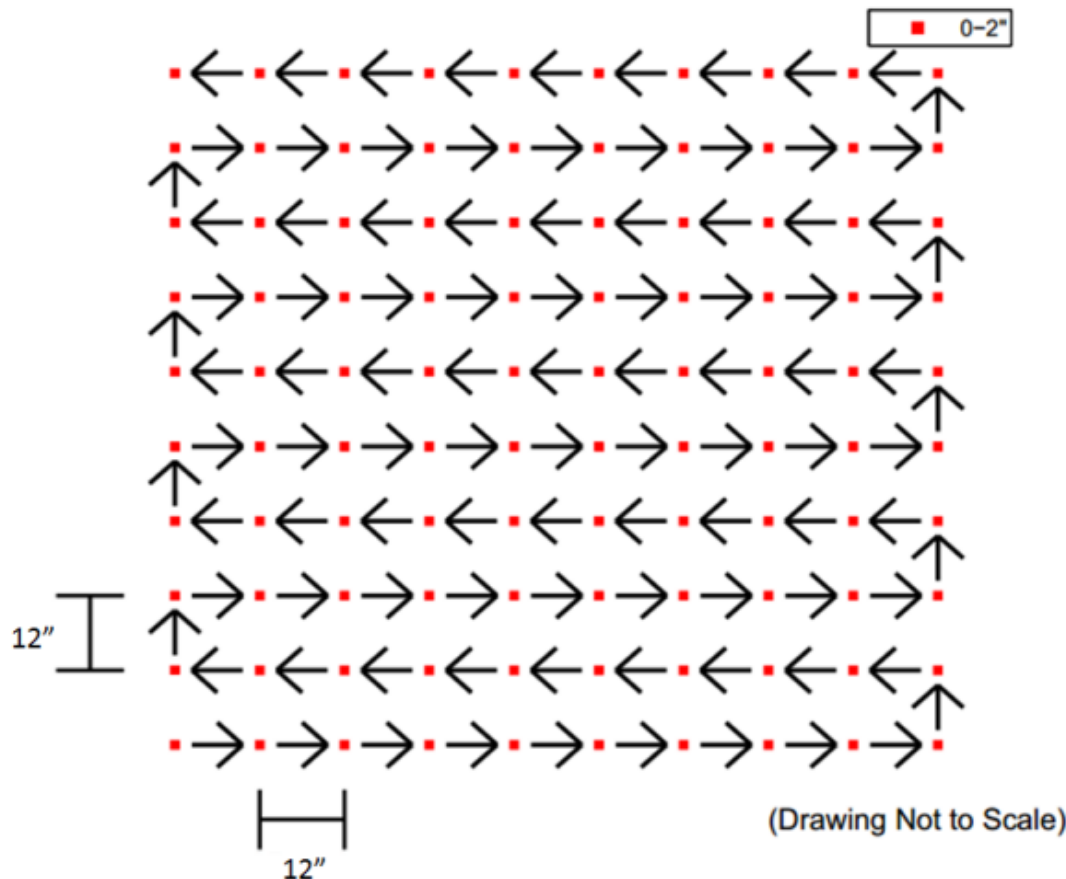
# The CoCoRaHS Soil Moisture Measurement



- ❑ 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

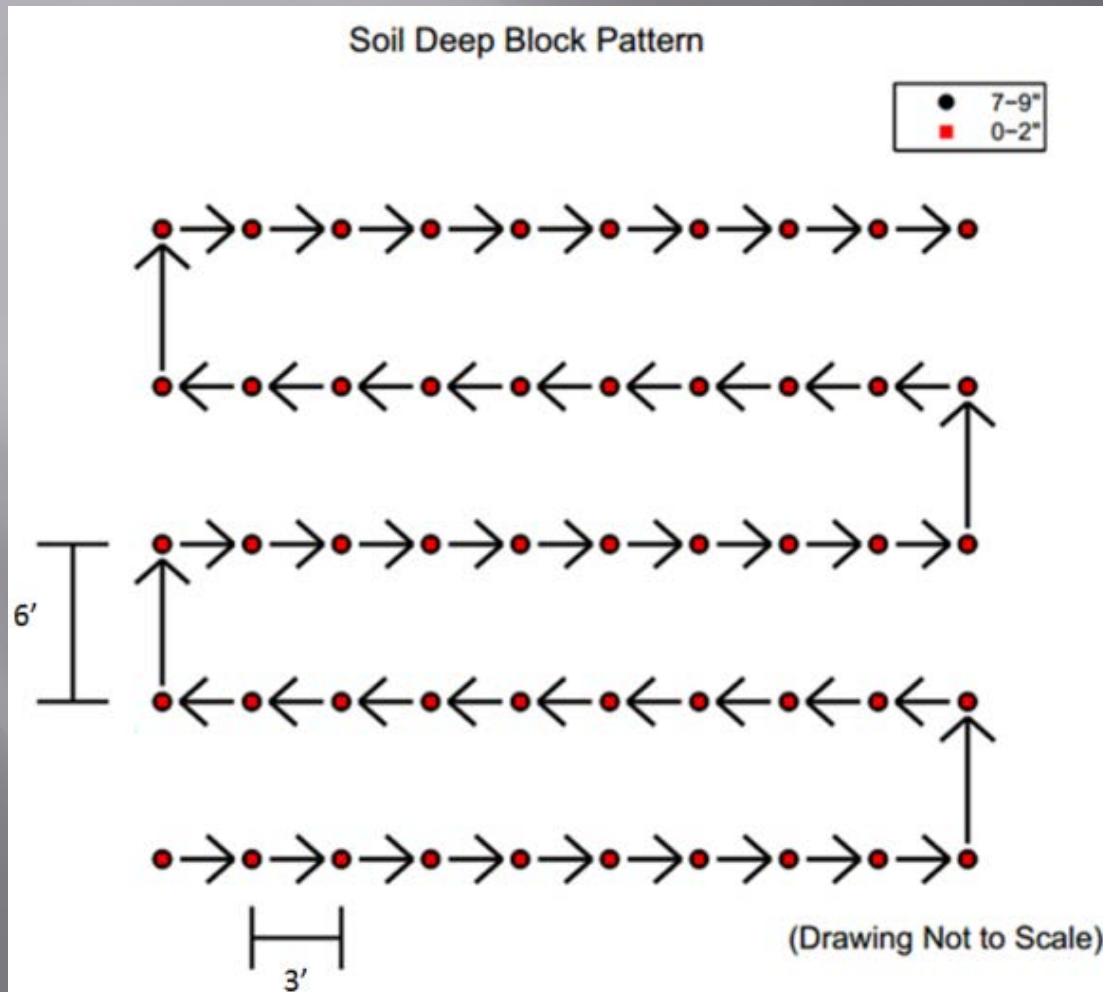
# A Protocol Heavily Inspired by GLOBE

Soil Surface GLOBE SMAP Block Pattern



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

# The Soil Deep Reporting Pattern



- 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

# Inception of CoCoRaHS Soil Moisture

## U.S. Drought Monitor CONUS

**June 26, 2012**  
(Released Thursday, Jun. 28, 2012)  
Valid 7 a.m. EST

Drought Conditions (Percent Area)

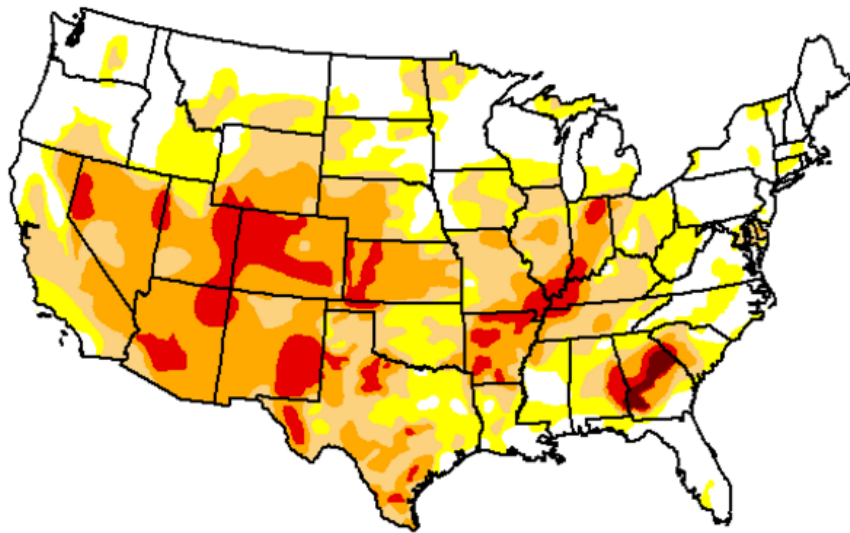
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
<b>Current</b>	27.99	72.01	51.13	30.73	8.54	0.41
<b>Last Week</b> 6/19/2012	31.22	68.78	46.72	24.27	5.19	0.29
<b>3 Months Ago</b> 3/27/2012	43.56	56.44	35.93	19.40	6.72	2.15
<b>Start of Calendar Year</b> 1/3/2012	50.41	49.59	31.90	18.83	10.18	3.32
<b>Start of Water Year</b> 9/27/2011	56.45	43.55	29.13	23.44	17.80	11.37
<b>One Year Ago</b> 6/28/2011	63.03	36.97	28.08	23.28	18.38	11.94

### Intensity:

 D0 Abnormally Dry	 D3 Extreme Drought
 D1 Moderate Drought	 D4 Exceptional Drought
 D2 Severe Drought	

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

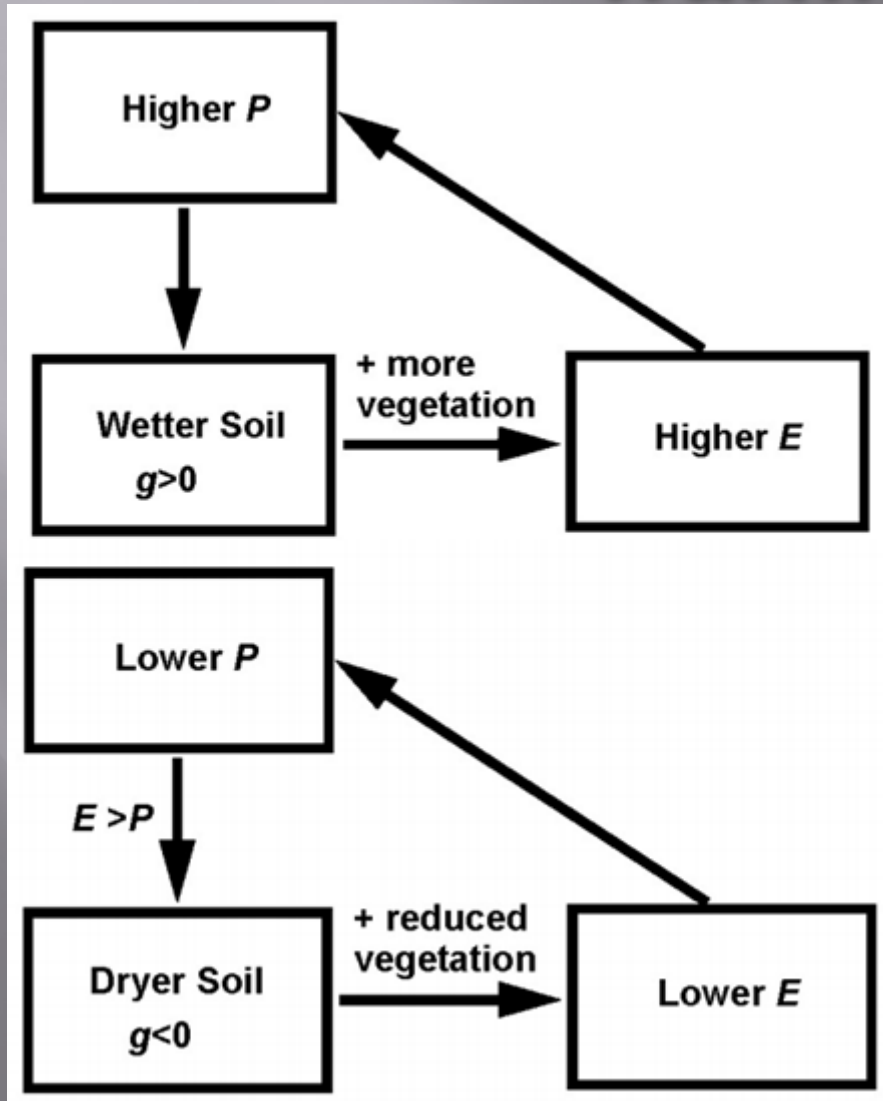
**Author(s):**  
Richard Heim  
NCDC/NOAA



- 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

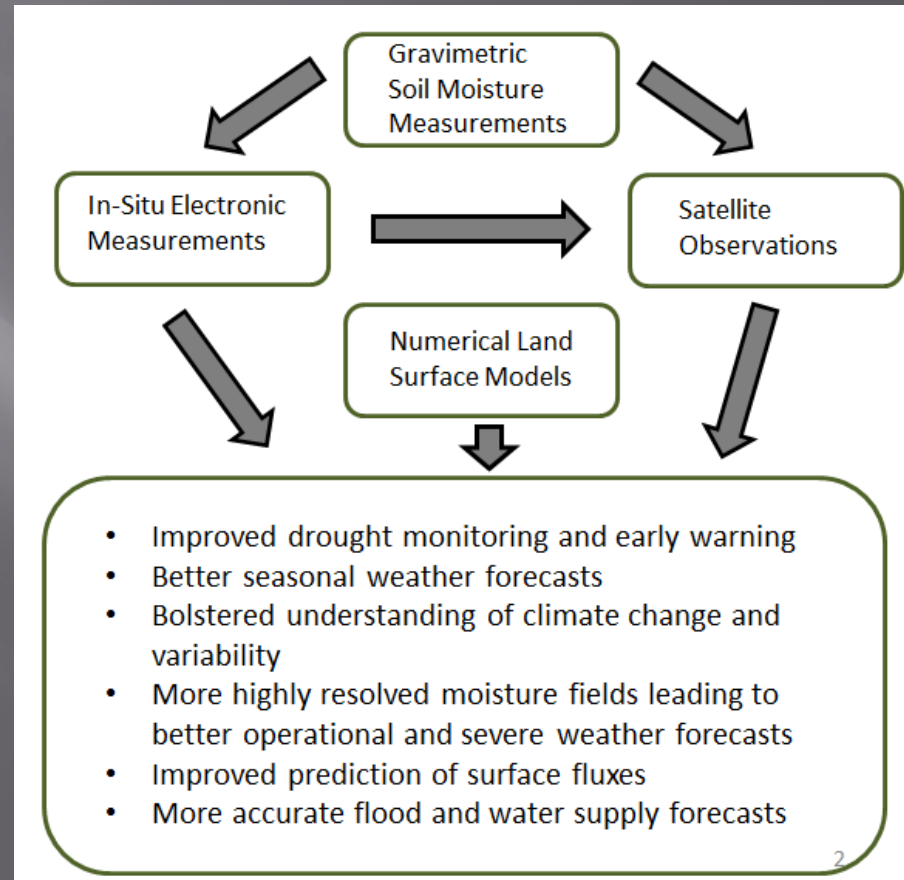
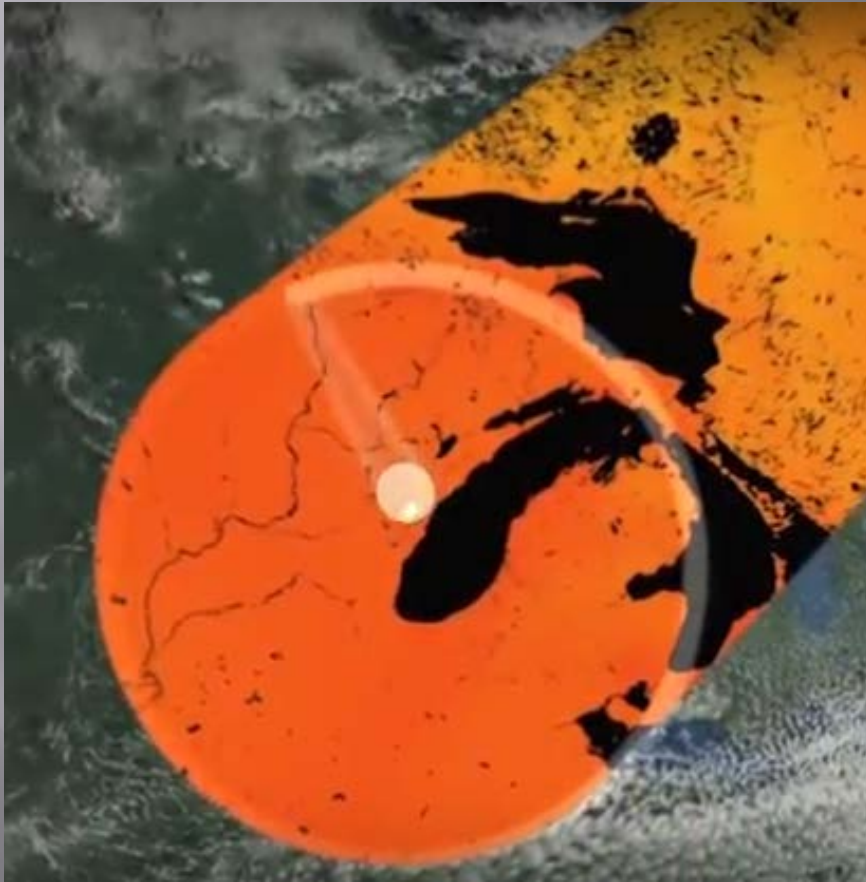


- The atmosphere is chaotic; this makes seasonal forecasting difficult. Soil moisture data is less temporally chaotic, and may offer a partial solution
- If root zone soils are drier (wetter) than usual, it may cause increased subsequent seasonal dryness (wetness) on a seasonal timescale (a positive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





# CoCoRaHS' Roll in the Grand Scheme



# 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



# What Does the Form Look Like?

## My Data Entry : Soil Moisture Report Form

**Soil Moisture Report Form** Submit Data Reset

Station Number : CO-LR-1107

Station Name : Fort Collins 4.5 WNW

\* Denotes Required Field

1 →  \*Observation Date ?

2 →  AM \*Observation Time ?

3 →

Observation Notes: (This will be available to the public) ?

Information about where the sample was taken

Distance from previous sample in meters:  ← 4

Is the land irrigated?  Yes  No ← 5

Did you begin a new row?  Yes  No ← 6

Soil Samples

Depth	Soil Type	Weight Before Drying (grams)	Volume of Rocks and Roots Removed(cm3)	Weight After Drying (grams)
0-2"	<input type="text" value="Sandy Clay"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
7-9"	<input type="text" value="Sandy Clay Loam"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

7 →  (Soil Type)

8 →  (Weight Before Drying)

9 →  (Volume of Rocks and Roots Removed)

10 →  (Weight After Drying)

Submit Data Reset

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

# What Does a Completed Submission Look Like?

## Soil Moisture Report

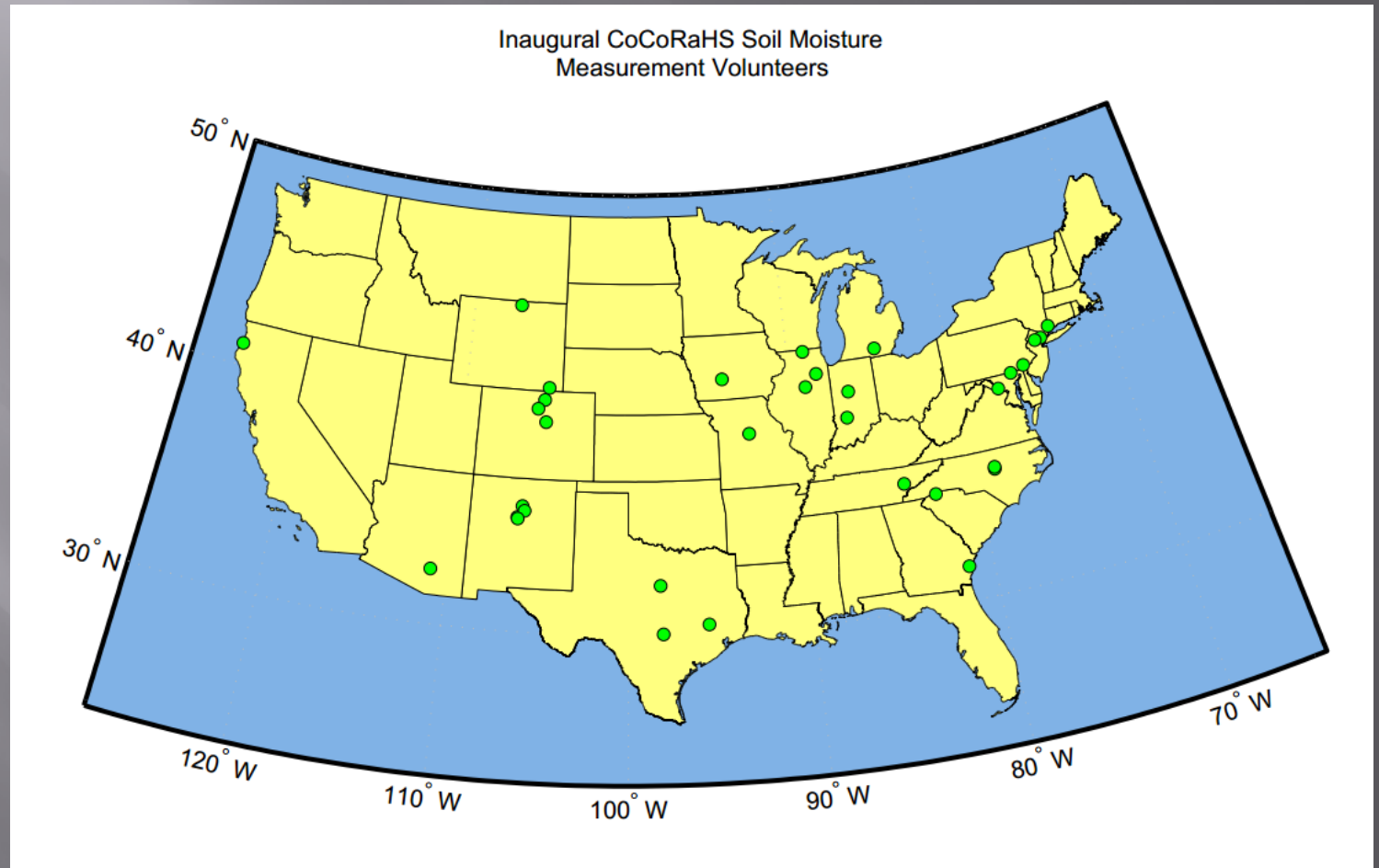
<b>Station Number</b>	NM-SF-70	<b>Observation Date</b>	5/2/2017
<b>Station Name</b>	Santa Fe 10.5 S	<b>Observation Time</b>	4:30 PM
<b>Submitted</b>	5/13/2017 11:24 AM	<b>Is Soil Irrigated</b>	False
<b>Is Sample Part Of New Row</b>	False	<b>Meters From Previous Sample</b>	0

Depth	Pre-Dry Weight (g)	Dry Weight (g)	Volume Removed (cm <sup>3</sup> )	Dry Density (g/cm <sup>3</sup> )	Volumetric Water Content(%)	Soil Type
0-2"	456	404	2.0	1.61	20.80	
7-9"	--	--	--	--	--	

Notes

# 2016 Recruits

- 33 volunteers have shared their interest with Nolan
- Samples promised from diverse climate regions and soil types





# Limiting Barriers to Entry



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 Gardener can be targeted

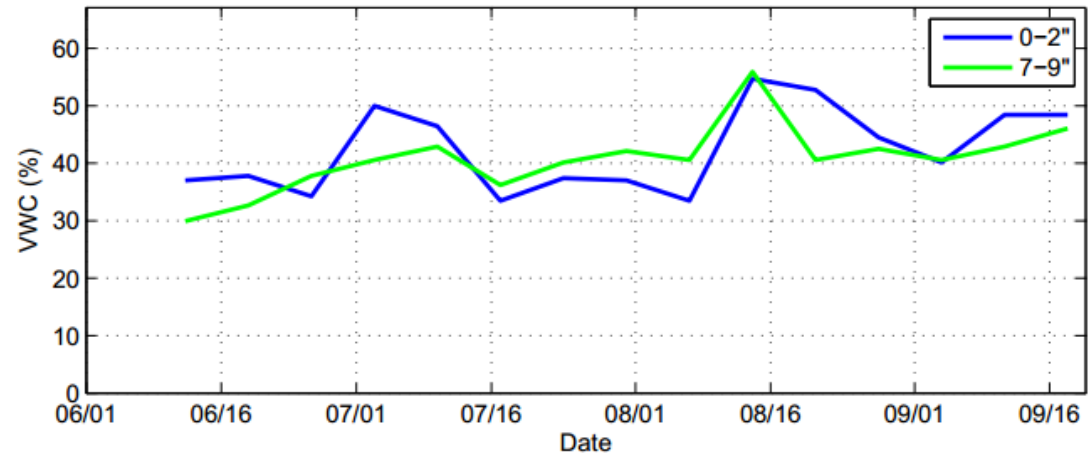




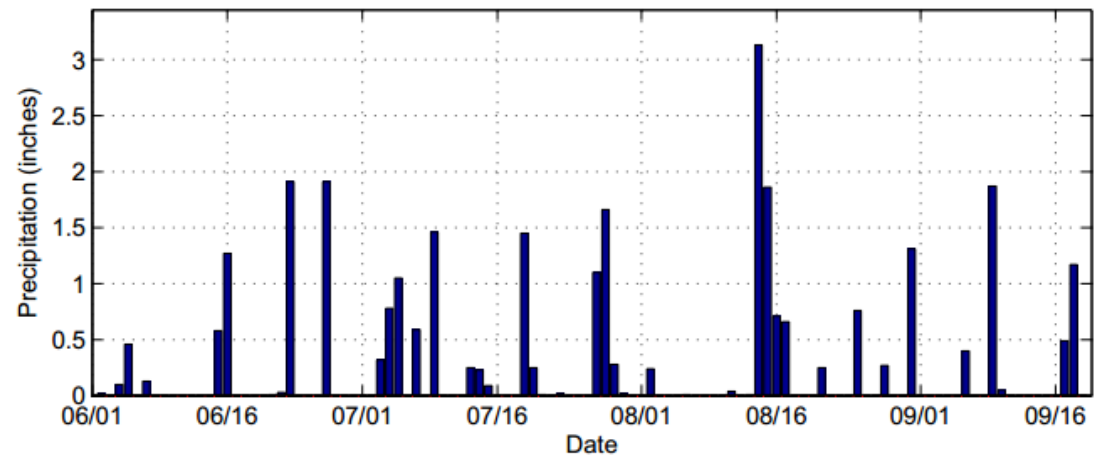
# Coming down the Pipe

- 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

IN-OW-9 Volumetric Water Content



IN-OW-9 Precipitation Measurements



# How can you help?

- ▣ 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](mailto:peter@cocorahs.org)

