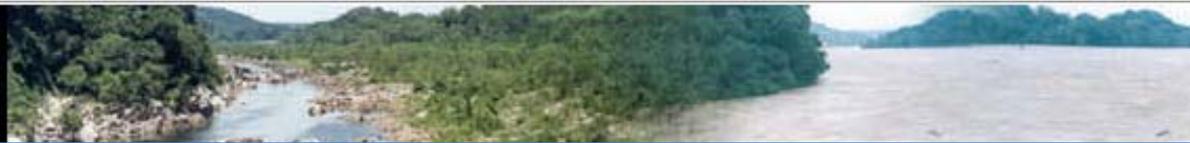


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# Advancing the National Soil Moisture Network

**Steven Quiring (Texas A&M), Jessica Lucido (USGS),  
& Mike Strobel (USDA NRCS)**  
[http://cida.usgs.gov/nsmn\\_pilot/](http://cida.usgs.gov/nsmn_pilot/)

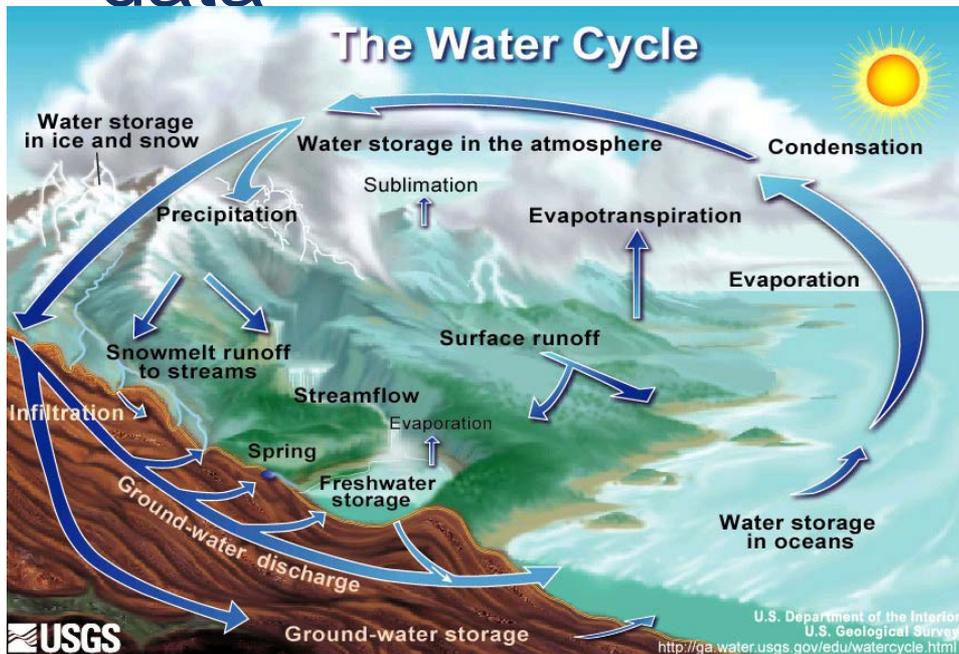
Veva Deheza (NIDIS), Roger Pulwarty (NIDIS), Chad McNutt (NIDIS), Jim Verdin (USGS)

USGS CIDA Staff: Luke Winslow, Jordan Read, Andrew Yan

TAMU Staff: Trent Ford, Zhongxia Li, Partha Baruah

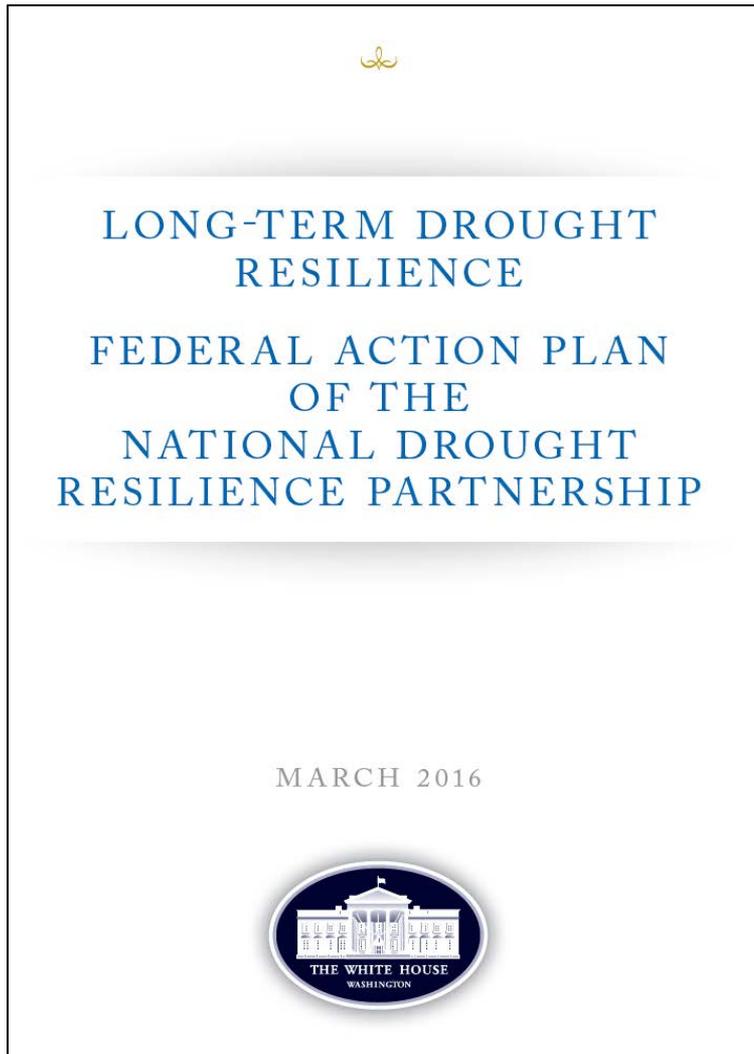
# Motivation

- President's Climate Action Plan (2013)
- Missing piece of hydrologic observational data



The screenshot shows the White House website header with navigation links: BLOG, PHOTOS & VIDEO, BRIEFING ROOM, ISSUES, and the ADMINISTRATION. Below the header, it says "Home • Briefing Room • Statements & Releases". The main content area is titled "FACT SHEET: President Obama's Climate Action Plan" and includes the sub-heading "President Obama's Plan to Cut Carbon Pollution Taking Action for Our Kids". A red-bordered box highlights a section titled "Managing Drought:" which states: "Leveraging the work of the National Disaster Recovery Framework for drought, the Administration will launch a cross-agency National Drought Resilience Partnership as a 'front door' for communities seeking help to prepare for future droughts and reduce drought impacts. By linking information (monitoring, forecasts, outlooks, and early warnings) with drought preparedness and longer-term resilience strategies in critical sectors, this effort will help communities manage drought-related risks."

# Motivation



## Goal 1: Data Collection and Integration

### Objective:

Agencies shall share data and information related to drought, water use, and water availability, including data on snowpack, groundwater, stream flow, and soil moisture with State, regional, tribal, and local officials to strengthen decisionmaking to support more adaptive responses to drought and drought risk.

### Implementation Actions:

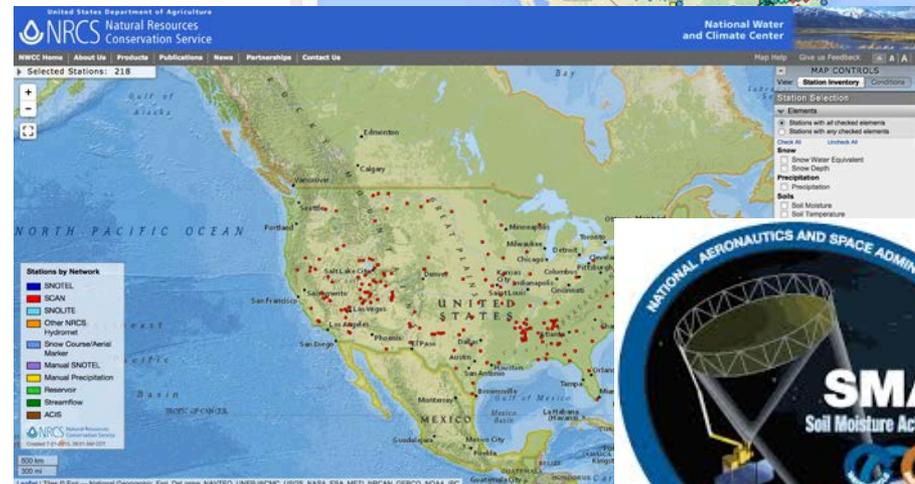
#### *Integrate Existing Data and Information Sources for Regional-Level Use*

- 1. Integrate Data from Key Platforms:** Assess, strengthen, and connect existing space-based, airborne, and terrestrial data-collection and monitoring capabilities for water use and availability (e.g., capabilities at DOI-USGS, USDA, DOC-NOAA, EPA, NASA, and free and open data from the private sector). Major data-collection and monitoring capabilities should include capabilities for assessing: (1) groundwater, including quality and connections with surface waters; (2) soil moisture; (3) snowpack; (4) water use; and (5) surface water, including quality. Using principles of the Open Water Data Initiative, enhance the interoperability of information obtained through these capabilities with data obtained through surveys and reporting, to better characterize water supplies and drought-risk conditions, and to identify information gaps. Make data and information easily accessible to stakeholders in formats compatible for inclusion into existing geospatial data platforms. Integrate data on drought into health platforms, such as the Environmental Public Health Tracking Network.

- **Lead Coordinating Agencies:** DOI-USGS, DOC-NOAA, USDA, and OSTP
- **Supporting Agencies:** EPA, NASA, DOE, HHS-CDC

# Current Soil Moisture Data Sources

- SCAN & CRN & Others
  - In situ
  - National coverage
  - Real-time & historical
  - Limited web service access
  - Multiple depths
- NASMD
  - In situ
  - Historical
  - National coverage
  - Multiple depths
- SMOS, NLDAS, SMAP
  - Satellites & models
  - National coverage
  - Near real-time
  - Near surface data



# Pilot Use Cases

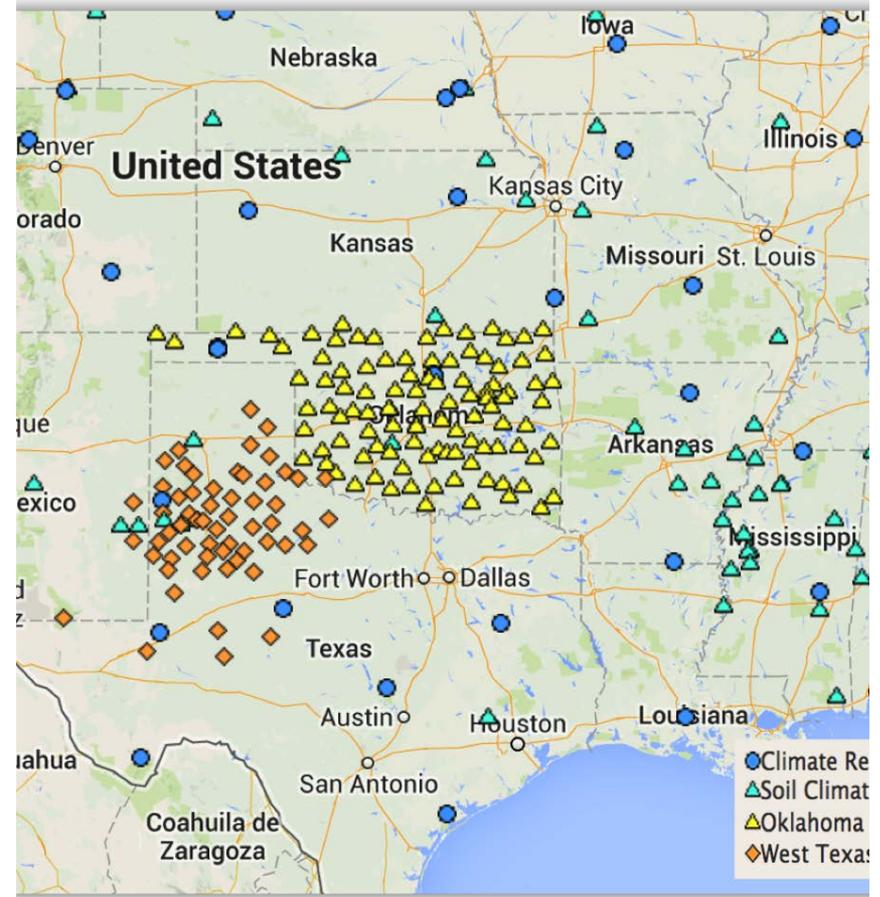
1. Operational Drought Monitoring: NOAA, U.S. Drought Monitor
2. Experimental Land Surface Modeling: NOAA/NOHRSC, Snow Modeling
3. Operational Hydrological Modeling: NOAA RFCs

# Goal

As a U.S. Drought Monitor Author I want to see a map of percentile ranking of current volumetric water content (VWC) at discrete and common depths, related to 30 yr record, for sites colored using the drought monitor legend so that I can determine the necessary changes to be made to this week's DM map.

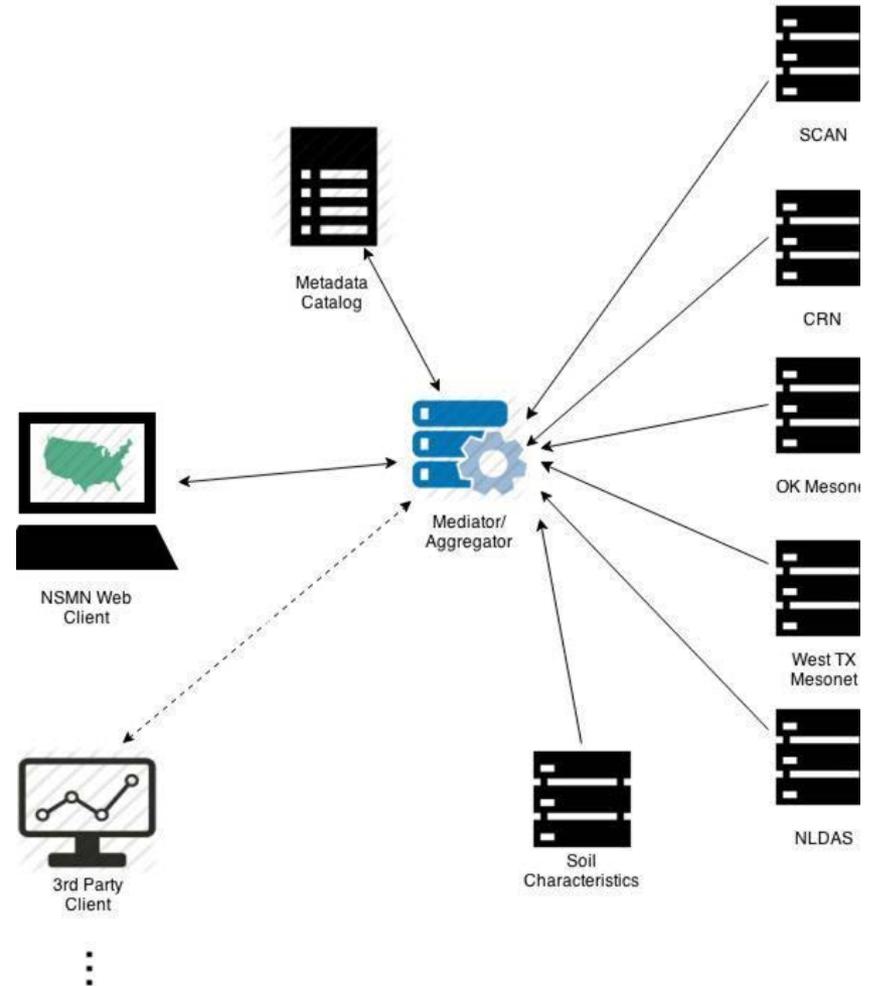
# Pilot Data Sets

- In Situ:
  - Climate Reference Network
  - SCAN & SNOTEL
  - Oklahoma Mesonet
  - West Texas Mesonet
- Modeled:
  - NLDAS-2 model-derived soil moisture from: Noah, Mosaic, SAC and VIC



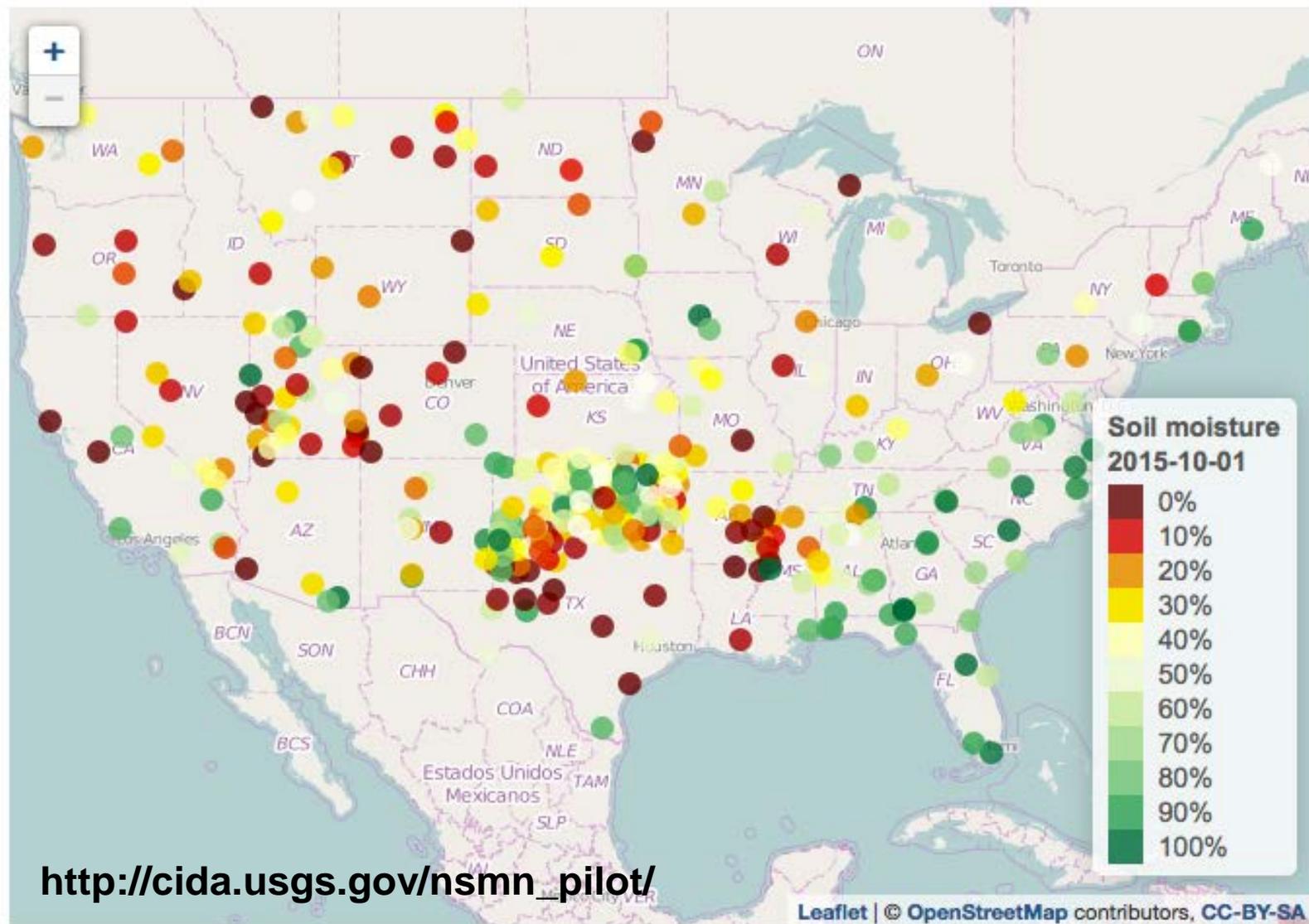
# System Components

- Site metadata and soil characteristics web service
- Catalog of data sets and service metadata
- CRN web service - [NCDC ArcServer](#) (does not include soil moisture)
- SCAN web service - [AWDB SOAP](#)
- OK Mesonet web service
- West TX Mesonet web service
- NLDAS web service - [USGS Geo Data Portal](#)
- Algorithm development for calculating percentiles, aggregating datasets
- Service mediator/aggregator
- Map-based visualization web tools



# National Soil Moisture Network

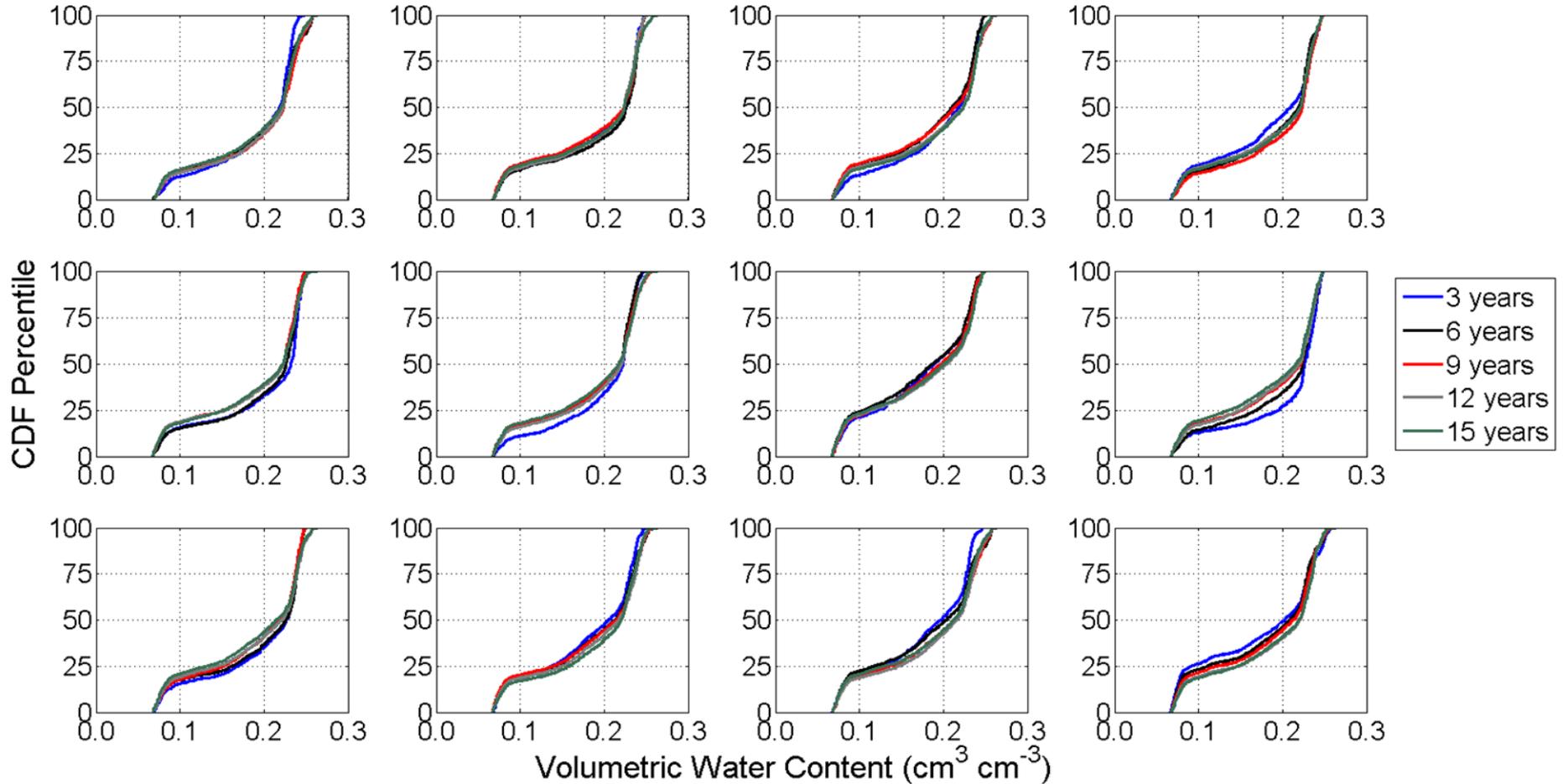
0-10cm



# NSMN- Pilot Work Completed

- Station metadata has been gathered
- Web services established for West Texas Mesonet, Oklahoma Mesonet and Climate Reference Network; TAMU is serving these data (temporary for pilot)
- Mediator coded to access and process all 4 networks
- Interactive map has been developed
- Analysis of historical data to calculate cumulative distribution functions (CDF)
- Quality control and percentile calculations have been automated
- Developed an SOS service for aggregated VWC data

# Soil Moisture Percentiles

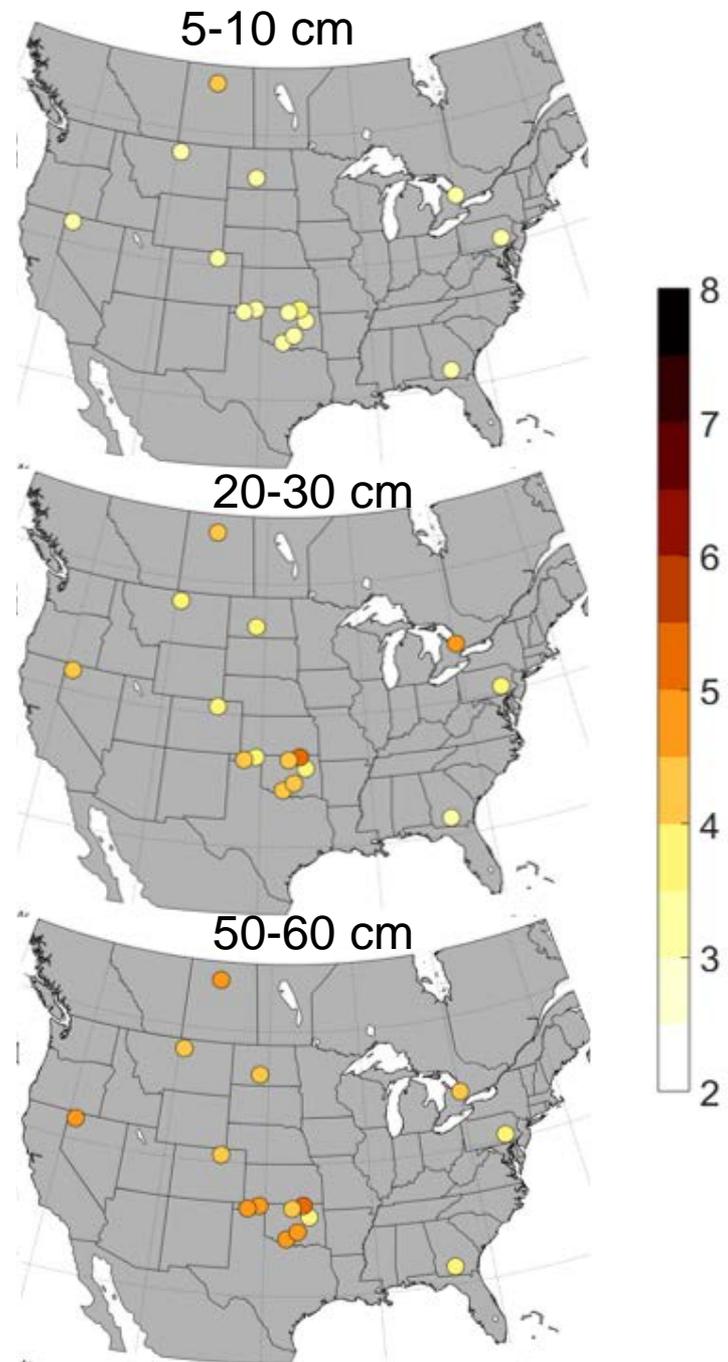


# Soil Moisture Percentiles

**Depth of measurement variations:** the average number of years of data that are necessary to generate stable soil moisture percentiles at each station.

The record length thresholds are determined using the Anderson-Darling test with a Bonferroni adjustment for measurements made at: 5-10 cm, 20-30 cm, and 50-60 cm

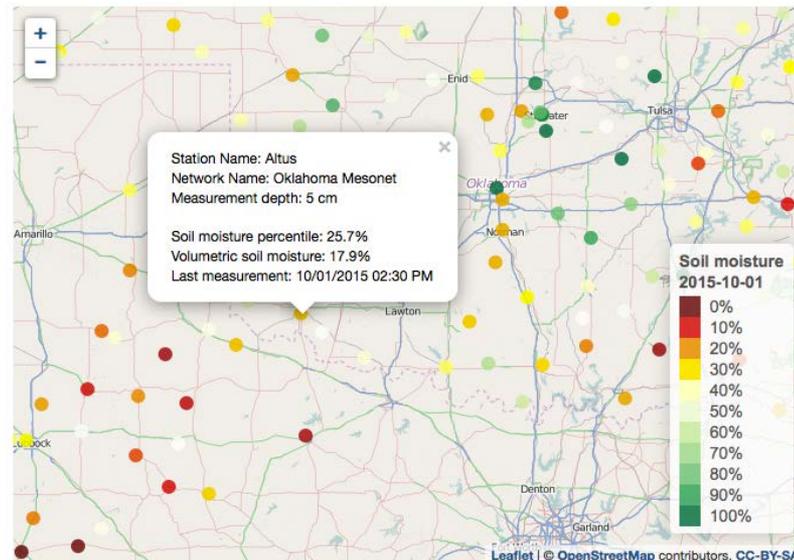
Ford et al. (submitted)



# Lessons Learned

- Most major in-situ networks do not currently serve soil moisture via web services
- Existing services often have little or no documentation
- Station metadata are not available via services
- Sites can be added or removed
- Although period of record is relatively short, stable percentiles can be estimated for most stations

0-10cm



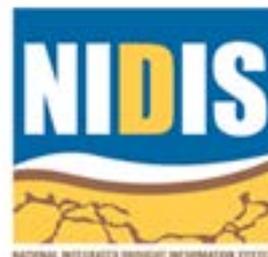
# Next Steps: Moving Beyond the Pilot

- **Build-out system infrastructure\***
- Integrate SMAP and NLDAS-2 data
- Survey federal, state and local agencies to identify soil moisture data sources and new use cases
- Incorporating new data sources
- Build industry partnerships
- Develop new tools, visualizations and data products
- Collaborate with the international soil science informatics community by participating in the OGC ADWG SoilE

[http://cida.usgs.gov/nsmn\\_pilot/](http://cida.usgs.gov/nsmn_pilot/)



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# National Soil Moisture Network Workshop

May 24 - 26, 2016

NOAA/National Integrated Drought Information System, Boulder, CO

- **Goals and Objectives:**
  - Coordinating soil moisture monitoring and assimilation activities across the federal landscape with states and other interests, including the private sector
  - Providing an update on the progress made on a Coordinated National Soil Moisture Network
  - Crafting a future direction and approach for a coordinated NSMN. Identifying the next steps, addressing who will be involved, and how and what needs to be accomplished
- Logistics: <https://joss.ucar.edu/meetings/2016/national-soil-moisture-network-workshop>
- Registration:
- <https://joss.ucar.edu/forms/2016/national-soil-moisture-network-workshop-registration>

# Contact Us

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