

# Building a Coordinated National Soil Moisture Monitoring Network

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# Meeting a critical need

Soil moisture data are critical for assessing:

- Drought conditions and operational drought monitoring
- Flood potential
- Experimental land surface modeling
- Estimates of crop yields
- Water supply forecasting
- Operational hydrologic models
- Impacts of climate change



# Goal

- President's Climate Action Plan
- National Drought Resilience Partnership
- National Integrated Drought Information System (NIDIS)
- Develop a Coordinated National Soil Moisture Network
- "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 the 30-year 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"



# Data-rich: Data-challenged

- Many sources of information
- Highly variable:
  - Spatial distribution
  - Vertical data collection
  - Sensor types
  - Scale
  - Time
  - Data storage (format, distribution)
  - Applications

# Integration

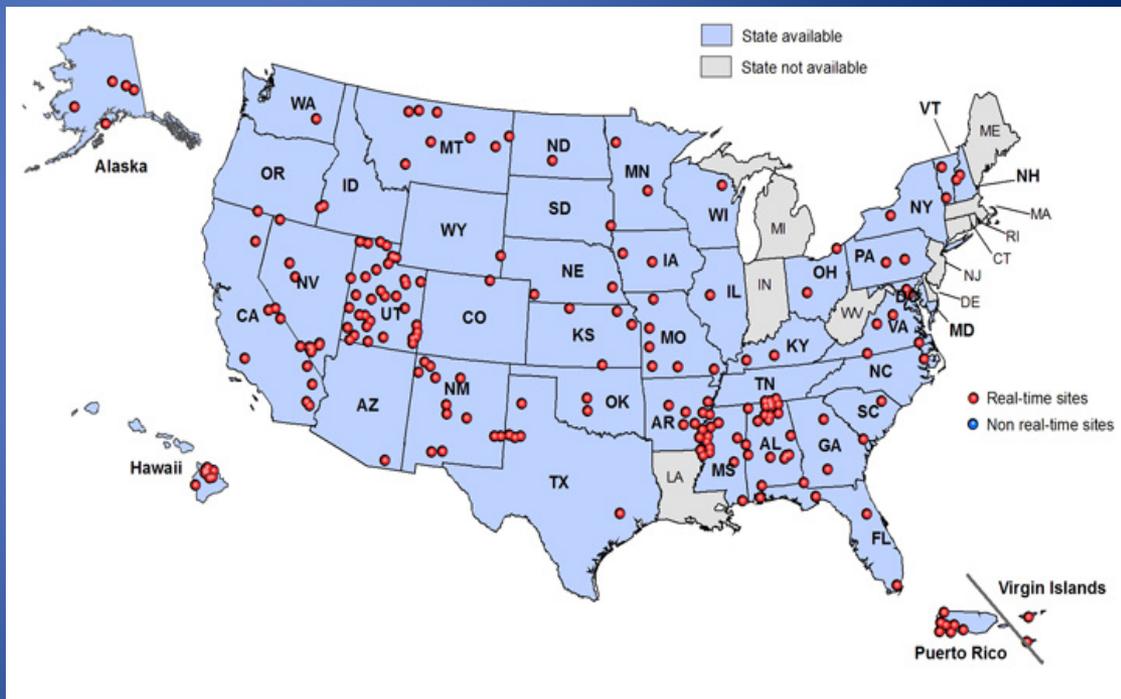
- In situ stations collecting point data
- Remote sensing at various scales
- Models



# Soil Climate Analysis Network

## SOIL CLIMATE ANALYSIS NETWORK

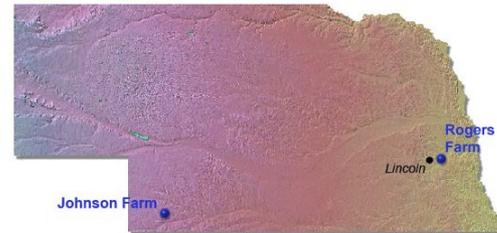
- **SCAN** (Soil Climate Analysis Network)
  - 221 sites in 40 States and US Territories
  - Soil-climate monitoring
  - Uses meteor burst telemetry
  - Critical for drought monitoring



# Johnson Farm, Nebraska SCAN Site

## SOIL CLIMATE ANALYSIS NETWORK

SCAN Sites for Nebraska

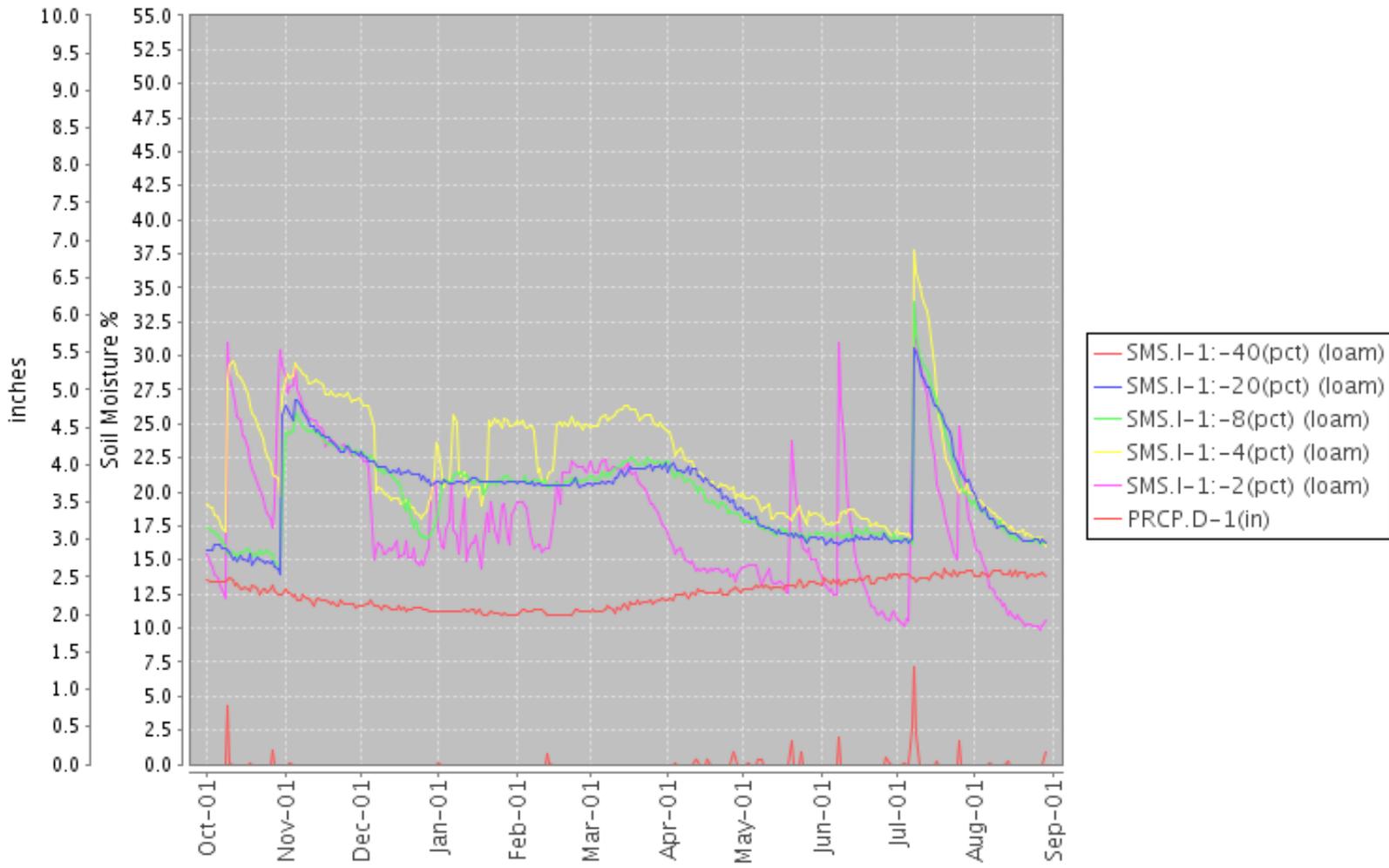


[< Back to Main SCAN Map](#)



# SCAN Data Plot

Station (2017) WATERYEAR=2012 (Daily) NRCS National Water and Climate Center - Provisional Data - subject to revision Wed  
 Aug 29 14:15:29 PDT 2012



Colorado  
 SCAN  
 Site  
 NUNN

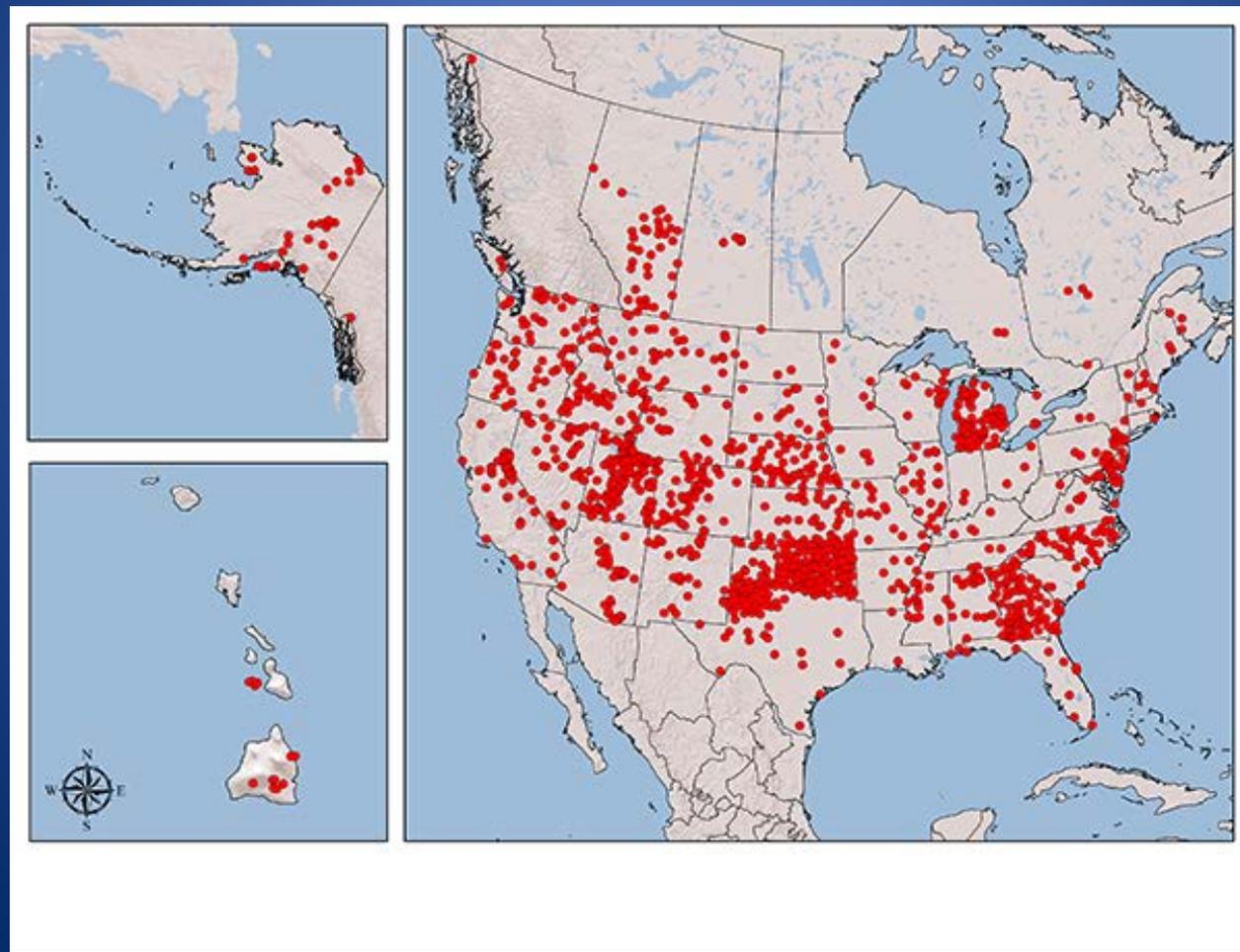


## Selected Representative In Situ Soil Moisture Networks in the United States

Network Name	Geographic Region	Number of Stations	Period of Record	Observing Depths (cm)
Agricultural Research Service (ARS)	Oklahoma	44	2005-present	5, 25, 45
AmeriFlux	United States	39	1997-present	Variable
Atmospheric Radiation Measurement (ARM)	Kansas, Oklahoma	17	1996-present	5, 15, 25, 35, 60, 85, 125, 175
Automated Weather Data Network (AWDN)	Nebraska	52	2006-present	10, 25, 50, 100
Climate Reference Network (CRN)	United States	114	2009-present	5, 10, 20, 50, 100
Cosmic Ray Soil moisture Observing Station (COSMOS)	United States	54	2008-present	Variable
Delaware Environmental Observing System (DEOS)	Delaware	29	2004-present	5
**Georgia Automated Environmental Monitoring Network (GAEMN)	Georgia	79	1992-present	Variable
Illinois Climate Network (ICN)	Illinois	19	1988-present	5, 10, 20, 50, 100, 150
Kansas Mesonet	Kansas	15	2008-present	5, 10, 20, 50, 100
Michigan Enviro-weather (Automated Weather Network, MAWN)	Michigan, Wisconsin	80	2000-present	5, 10
Missouri Agriculture Weather Network (MAW)	Missouri	8	2002-present	5, 10
**New Jersey Mesonet	New Jersey	10	2003-present	5
NOAA Hydrometeorological Testbed	Western U.S.	25	2004-present	Variable
North Carolina EcoNet	North Carolina	36	1999-present	20
Oklahoma Mesonet	Oklahoma	113	1998-present	5, 25, 60, 75
**Remote Automated Weather Stations (RAWS)	Western U.S.	50	1983-present	Variable
Snowpack Telemetry (SNOTEL)	Western U.S.	414	2000-present	Variable
Soil Climate Analysis Network (SCAN)	United States	203	1996-present	5, 10, 20, 50, 100
South Dakota Automated Weather Network (SDAWN)	South Dakota	11	2000-present	5, 10, 20, 50, 100
UA Fairbanks Water and Environmental Research Center (WERC)	Alaska	24	2000-present	Variable
West Texas Mesonet	Texas, New Mexico	64	2000-present	5, 20, 60, 75

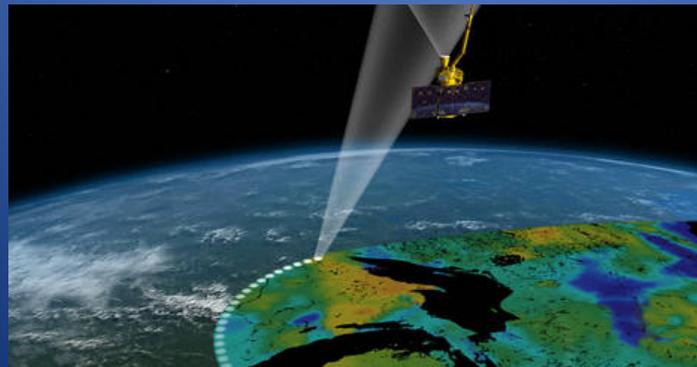


# Texas A&M University North American Soil Moisture Database



# Remote Sensing Observations

- NOAA – soil moisture remote sensing through microwave and thermal infrared observations
- NASA – Recent launch of Soil Moisture Active/Passive (SMAP) satellite
- University of Arizona - Cosmic-Ray Soil Moisture Observing System (COSMOS)





# Modeling

- Major land surface models:
  - The Noah
  - Variable Infiltration Capacity (VIC)
  - Sacramento (SAC)
  - Mosaic
  - Catchment
  - CPC Leaky Bucket (CPC LB)
  - Simple Biosphere (SiB)
  - Tiled ECMWF Scheme for Surface Exchanges over Land (TESSEL) LSMs
- NASA and NOAA – The North American Land Data Assimilation System (NLDAS-2) - multi-model approach



## Coordination of Data Collection

- Models and remote sensing data provide spatial coverage of soil moisture for the U.S., but have coarse resolution
- Models generally only model near-surface soil conditions
- Models need to be calibrated to in situ measurements
- Different in situ networks provide differing data sets



# Kansas City Workshop

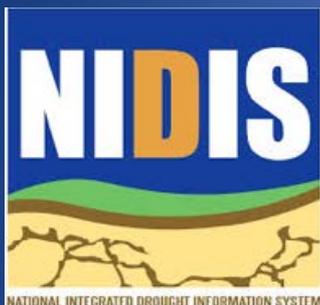
## November 2013

- Presented representative networks and models from various Federal, State and University groups.
- Next steps:
- Established a working group to address issues of scale and spatial distribution for networks, remote sensing platforms and modeling efforts
- Developing a nation-wide product from existing soil moisture data as a template for guiding a larger-scale effort
- Initiating a pilot soil moisture monitoring system for smaller regions to integrate all available soil moisture data types and assess how the data would be used by researchers, agencies and different sectors



United States Department of Agriculture  
Natural Resources Conservation Service

# National Soil Moisture Network



Thank you

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