

Identifying New Opportunities: Developing a Coordinated National Soil Moisture Network

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Meeting a critical need

Soil moisture data are critical for assessing:

- Drought conditions
- Flood potential
- Estimates of crop yields
- Water supply forecasting
- Hydrologic models
- Impacts of climate change

Goal

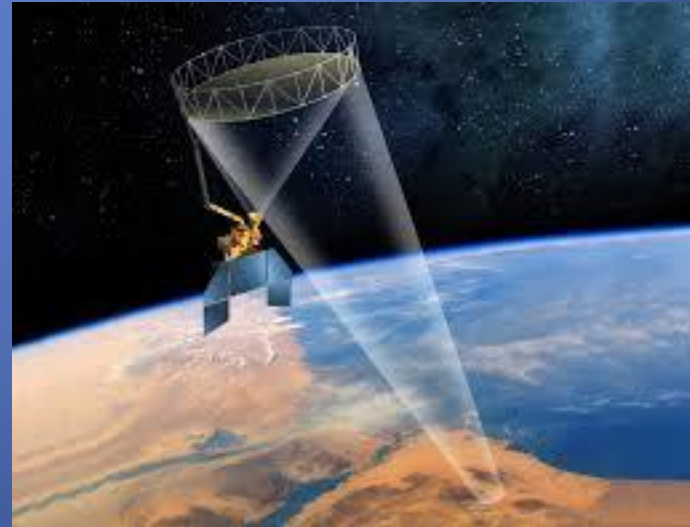
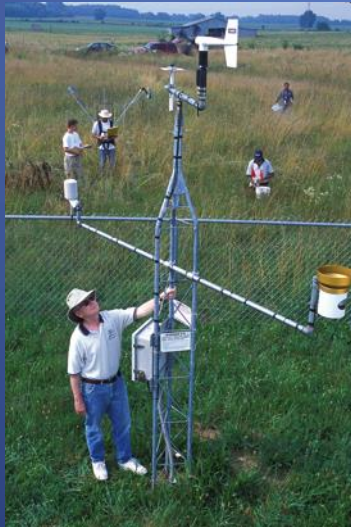
- President's Climate Action Plan
- National Drought Resilience Partnership
- National Integrated Drought Information System (NIDIS)
- Develop a Coordinated National Soil Moisture Network

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

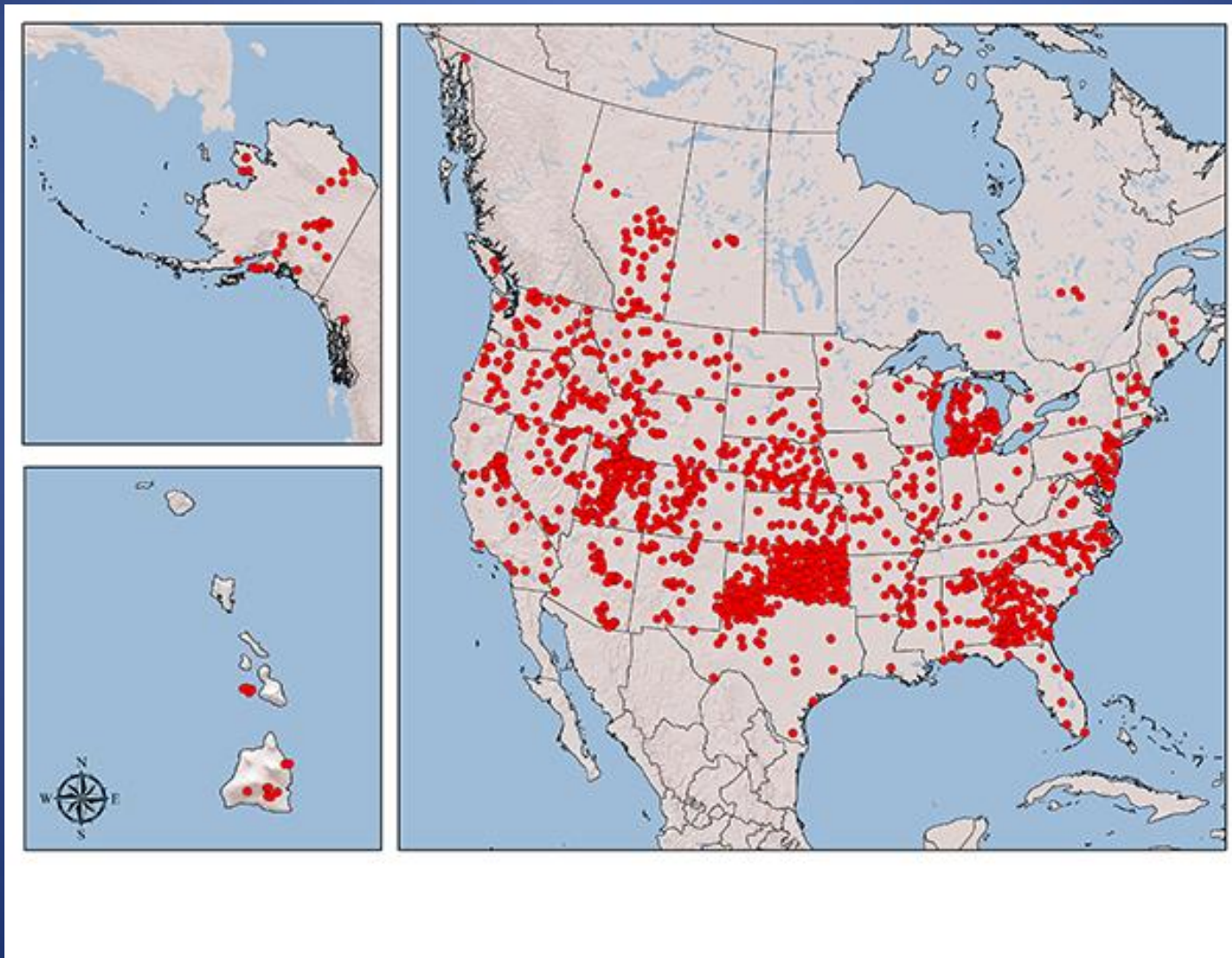
- In situ stations collecting point data
- Remote sensing at various scales
- Models



Selected Representative In Situ Soil Moisture Networks in the United States

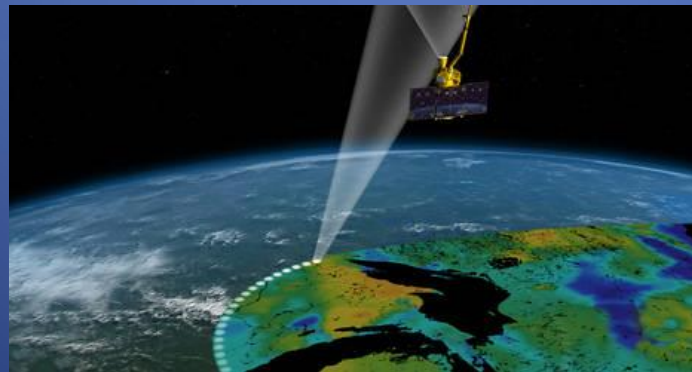
Network Name	Geographic Region	Number of Stations	Period of Record	Observing Depths (cm)
Agricultural Research Service (ARS)	Oklahoma	44	2005-present	5, 25, 45
AmeriFlux	United States	39	1997-present	Variable
Atmospheric Radiation Measurement (ARM)	Kansas, Oklahoma	17	1996-present	5, 15, 25, 35, 60, 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) - 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

Pilot Data Sets

In Situ:

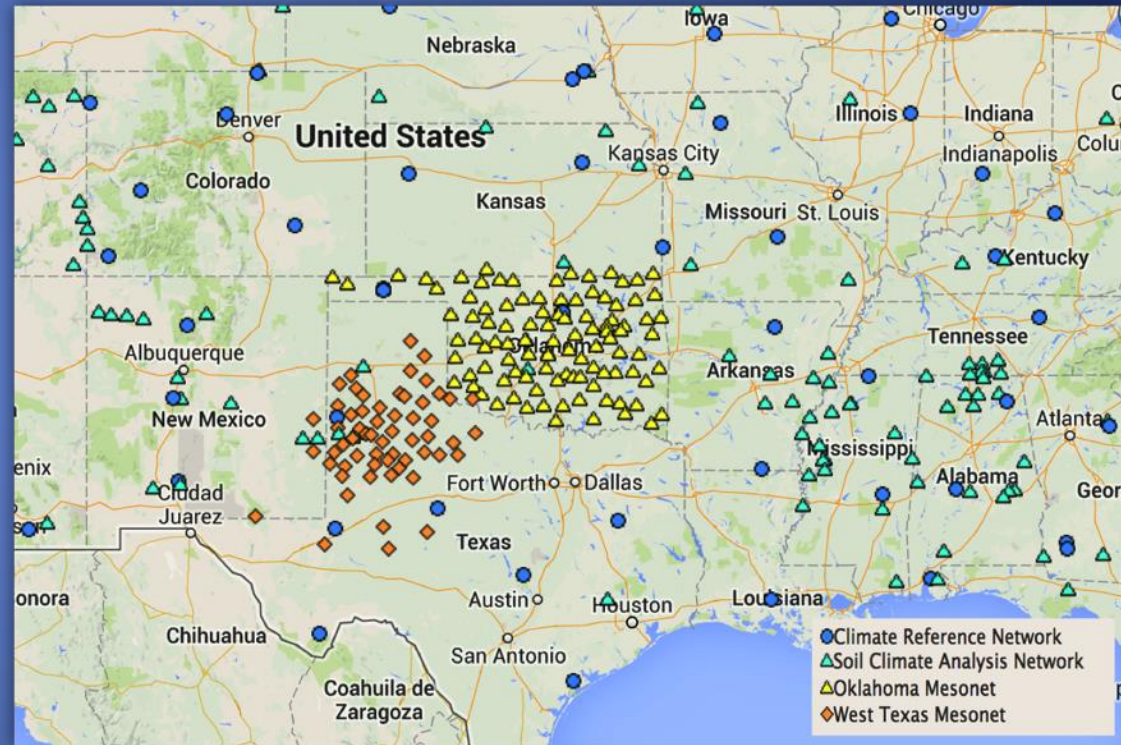
- Oklahoma Mesonet
- West Texas Mesonet
- US CRN
- SCAN

Station Metadata:

- NASMD

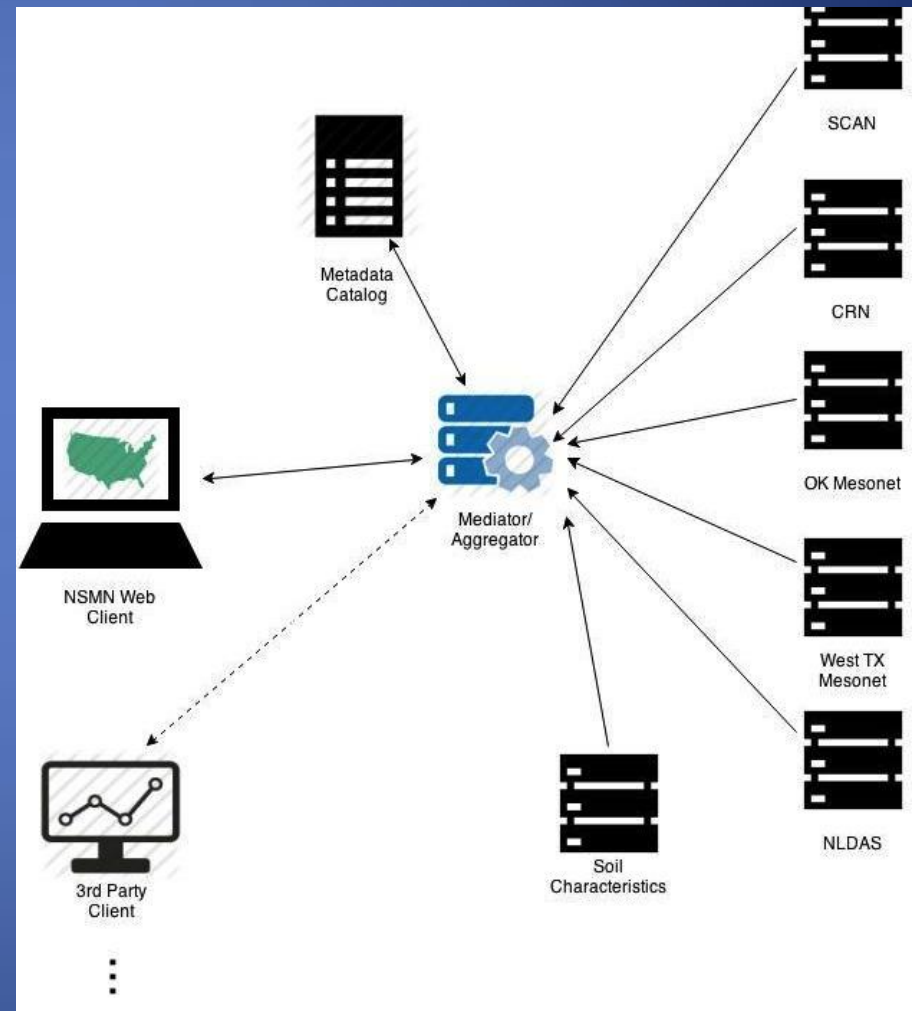
Modeled/Assimilated:

- NLDAS



Pilot System Components

- Site metadata and soil characteristics web service - Re-factor NASMD
- Catalog of data sets and service metadata
- CRN web service - [NCDC ArcServer](#)
- 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



Pilot Objectives

- Proof-of-concept near real-time soil moisture network implementation
- Demonstrate the potential usefulness of a coordinated effort
- Demonstrate the benefits of in situ soil moisture (and related products) to a broad range of end users
- Identify best practices for calibration/validation and metadata characterization
- Effectively leverages the full variety of existing networks and modeling efforts.

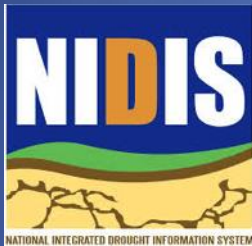
Pilot Timeline

- System Planning - December 2014
- Start Pilot Development - January 2015
- Submit Midway Progress Report - April 1, 2015
- Development Completed- July 1, 2015
- Demo Pilot - July/August 2015
- Final Project Report - August 31, 2015



United States Department of Agriculture
Natural Resources Conservation Service

National Soil Moisture Network



Questions?

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