

# Soil Moisture and Soil Temperature Observations and Applications from the NRCS SCAN and SNOTEL Networks

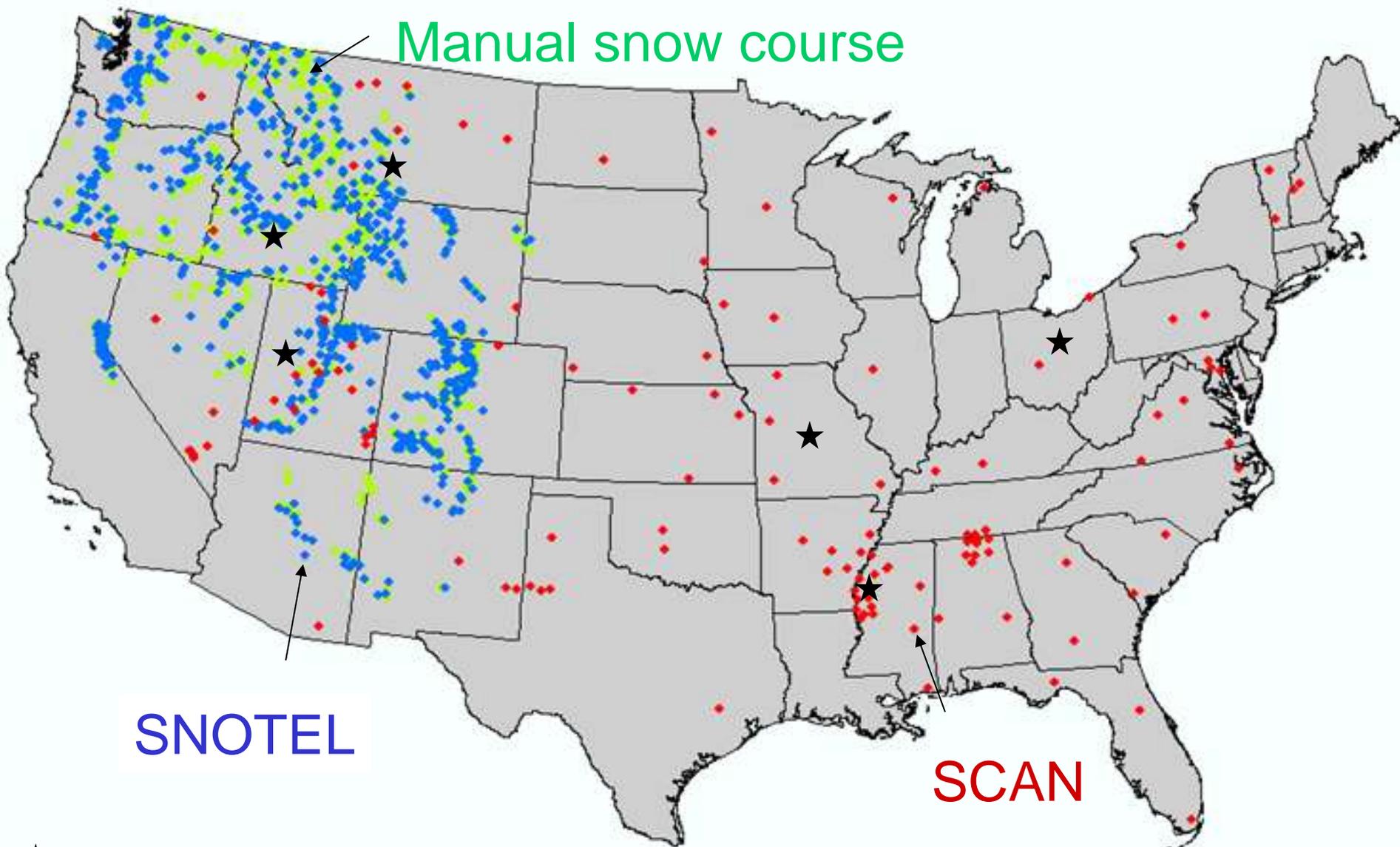
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# Soil Moisture Monitoring

- SCAN
  - Soil Climate Analysis Network
  - Monitors lower elevation areas for climate parameters and soil moisture monitoring nationwide
- SNOTEL
  - SNOW pack TELmetry
  - Monitors high elevation areas for snow water content, climate parameters, and soil moisture in the Western United States



★ Master stations in Utah, Idaho, Alaska, Ohio, Missouri, Mississippi, and Montana.

# Meteor-burst Technology



# Soil Climate Analysis Network (SCAN)

- SCAN
  - Started as a Soil Moisture/Soil Temperature Pilot Project between the National Water and Climate Center and the National Soil Survey Center in 1991 with 21 stations in 19 states
  - Interest continued to grow, and although not a formal program, SCAN now has 200 stations, most through cooperative efforts between NRCS and various partners
  - Currently working with the National Soil Survey Center to propose a full implementation of C-SCAN (a cooperative soil climate analysis network) that would have 3,000 stations integrating NRCS SCAN with networks operated by other agencies
  - NRCS goal will be to have new stations located on Benchmark soil series



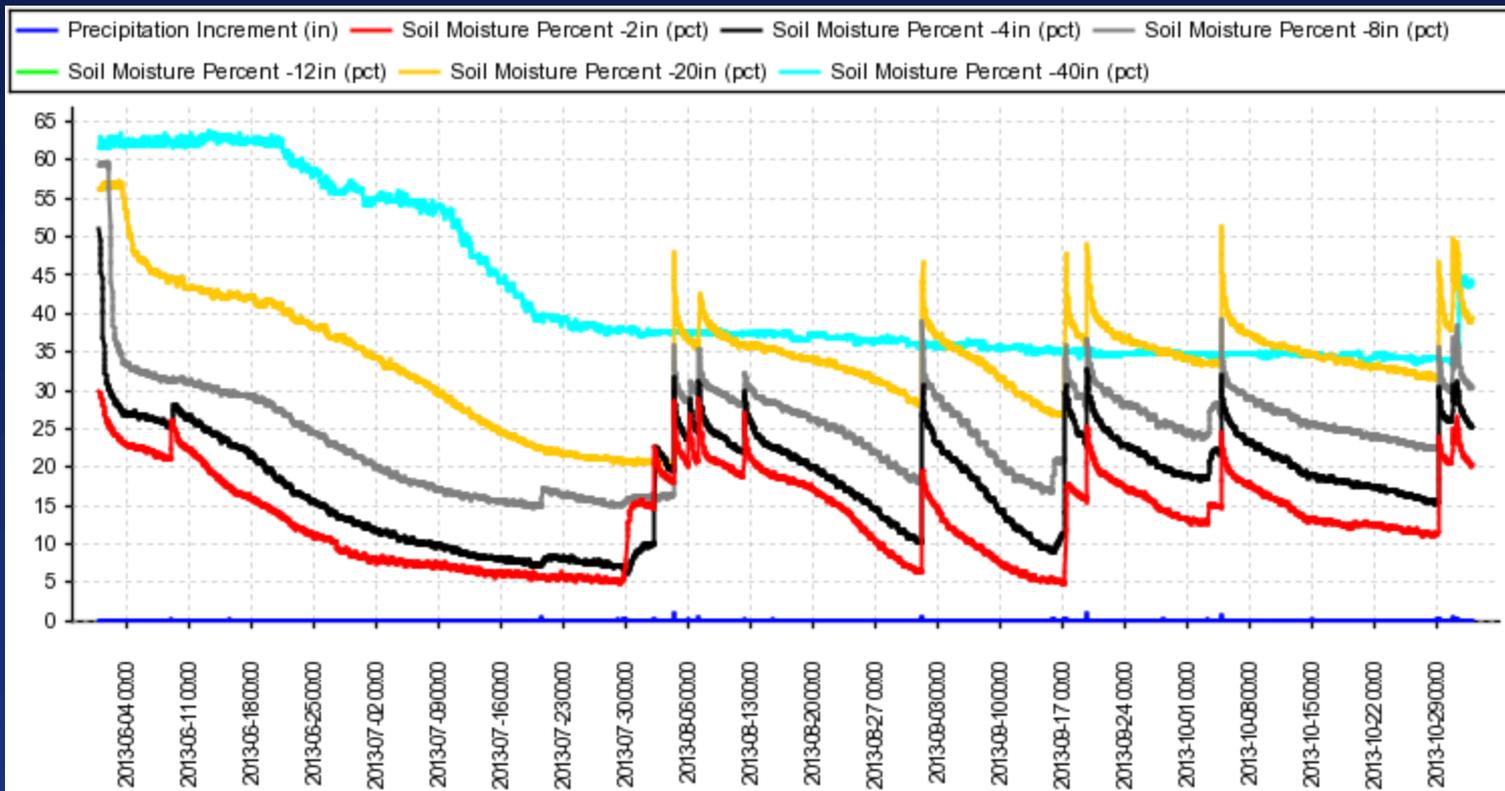
# Other SCAN Data Parameters

- Snow water content
- Snow depth
- Net radiation
- Redox
- Additional soil moisture and soil temperature measurements
- Water level
- Surface temperature
- Water quality parameters

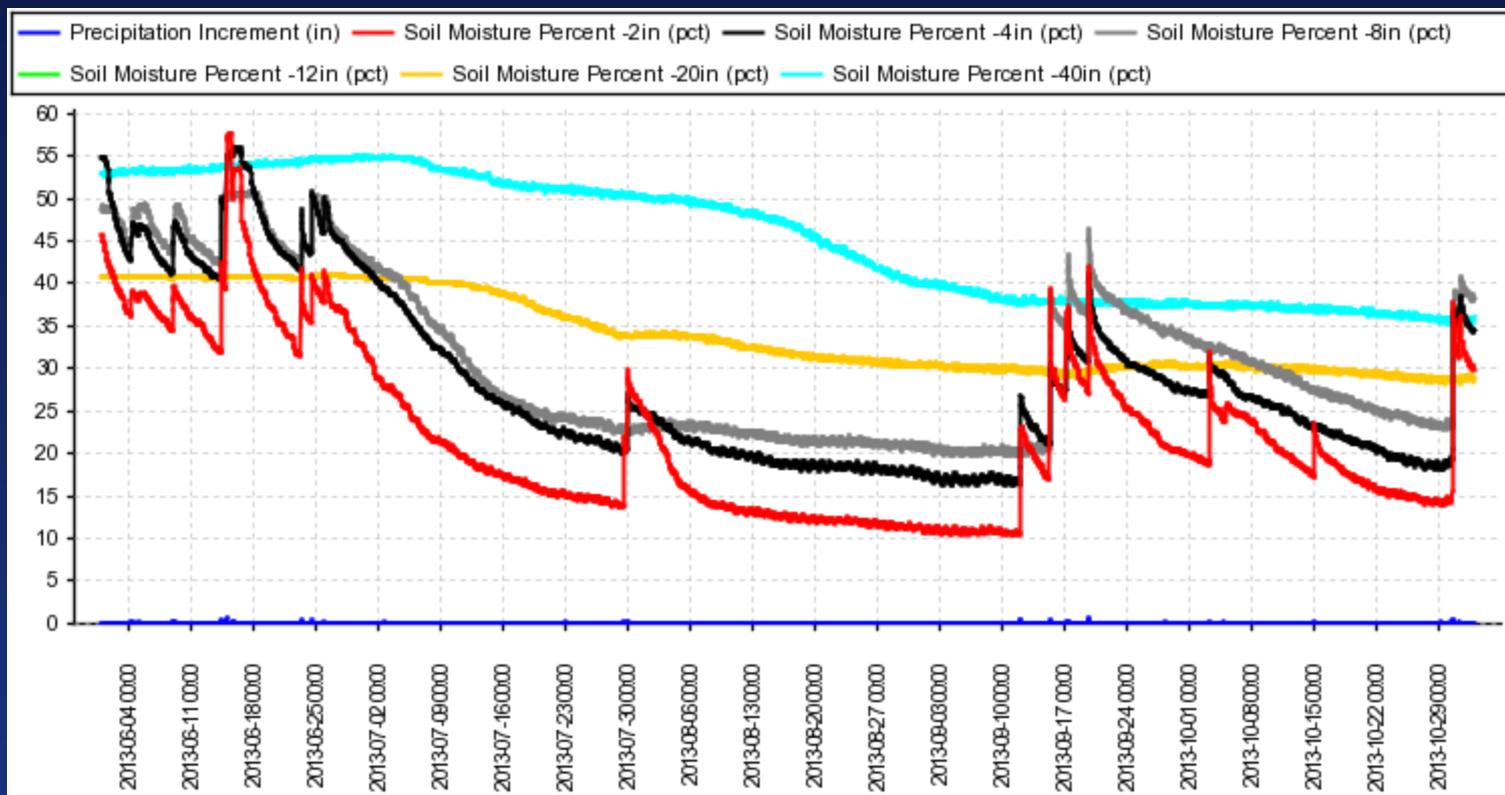


# Soil Moisture/ Precipitation

Kansas Site - Ku-nesa (2147)



### Missouri Site - Spickard (2047)

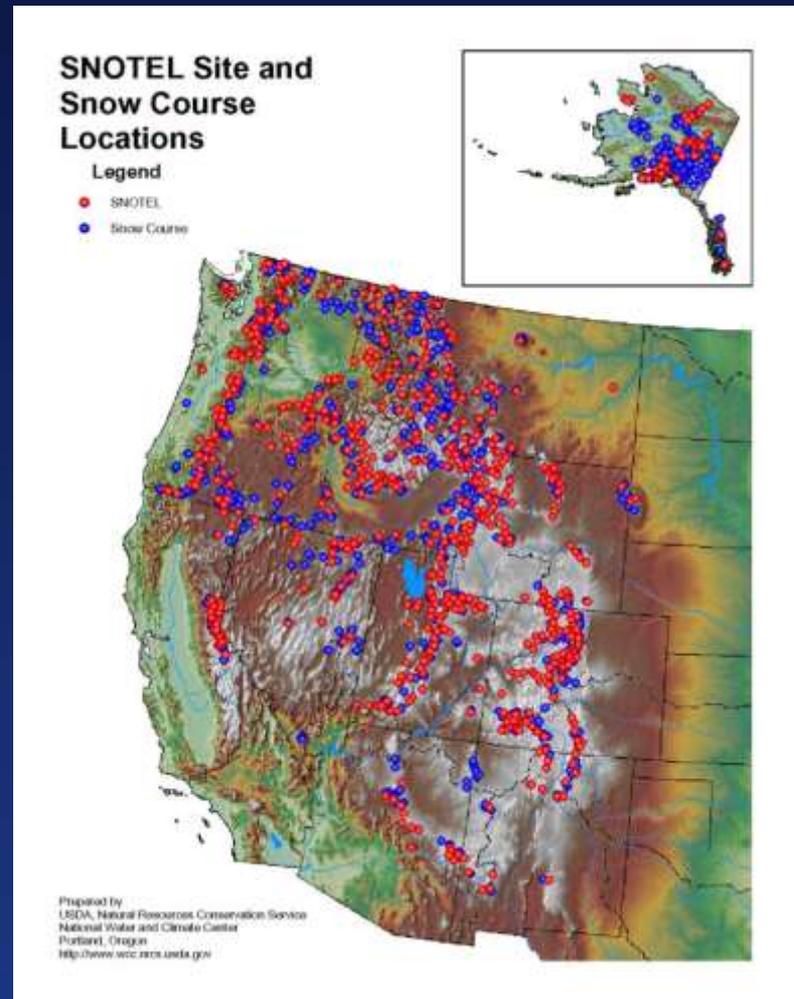


# SCAN Data

- All SCAN stations have full soil characterizations complete and available on the web
- All historic and real-time SCAN data are available on the web
  - <http://www.wcc.nrcs.usda.gov/scan>
- Special Reports
  - Special “Spreadsheet” compatible reports can be created

# SNOTEL Network

- Large Automated Climate Network
  - Began in 1978
  - 885 remote stations
  - Generally in high elevation areas
  - Located in the 12 Western States including Alaska
  - Mainly utilizes meteor burst communication technology to transmit data



# SNOTEL Parameters

- Typical Sensor Array
  - Snow water content
  - All season precipitation
  - Air temperature (maximum, minimum, and average)
  - Snow depth
  - Soil moisture and soil temperature at 421 stations (almost half of the network)

# SNOTEL Parameters

- Additional Sensors at Enhanced SNOTEL Stations
  - Solar radiation
  - Relative humidity
  - Wind speed and direction
  - Other sensors based upon customer requests

# Typical SNOTEL Station



# SCAN Siting Criteria

- All stations should be located on federal, state, county, or university lands. This will ensure long-term use of the land for monitoring purposes.
- All stations should be located in non-irrigated areas.
- First consideration be given to “Benchmark” soils.
- Consideration must be given to ensure that all Major Land Resource Area’s are represented in a given climatic region.
- The station must represent an agricultural area. Pasture, range, timber, and cropped areas must be considered first.
- When selecting a suitable location, some consideration of station security must be included.
- The first stations to be installed should be located in areas that are susceptible to drought.

# Soil Moisture/Soil Temperature Measurement

- NRCS uses a capacitance type of sensor.
- Steven Water “Hydro Probe” SDI-12 is currently used
- Installed at specific depths
- Full soil description and characterization analysis are done at each location
- Description and characterization data available to users from the Web



# Soil Description



# Sensor Placement and Layout

- The deepest sensor is installed first
- 40 inch installed vertically
- Hole is kept to a small size to minimize water transport



# Sensor Placement and Layout

- Sensors are placed horizontally at all other depths
- Sensors are dispersed around the small hole to minimize interference
- Compact the soil as each sensor is installed making sure the sensor is inserted completely into undisturbed soil



# Sensor Placement and Layout

- Sensor wires are moved to opposite side of hole and form a drip-loop
- Flex-conduit is used to protect sensor wires



# Data Uses for SCAN and SNOTEL

- Climate monitoring
- Water supply forecasting
- Drought assessment and mitigation
- Drought triggers
- Precision agriculture
- Soil survey interruption and mapping
- Crop production forecasts
- Range production and condition
- Disease and Pest prediction/mitigation
- Provide data for NWS and other agencies for flood forecasting and reservoir management
- Climate change assessment
- Water quality monitoring
- Air quality monitoring
- Underground utility lines

# Summary

- Between SCAN and SNOTEL, there are 628 stations with soil sensors
- SCAN and SNOTEL have a high benefit/cost ratio
- Provide a minimum of daily up to hourly data
- Expandable to meet demands
- Designed to be a cooperative program
- Requires maintenance to ensure data quality
- Diverse utility of the data
- Data are easily retrievable from the web page at <http://www/wcc.nrcs.usda.gov>
- Developing better tools to provide user with spatial soil moisture modeling