National Water and Climate Center
Snow Survey and Water Supply Forecasting Program
and SCAN

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Manual snow course

Master stations in Utah, Idaho, Ohio, Missouri, and Mississippi.
Manual Snow Surveys

Metal tube inserted into snow and weighed to measure water content.

+300,000 snow course measurements to date
NRCS SNOTEL Network

- SNOTEL network
  - 13 Western States
  - 885 sites (includes SnoLite)
  - More than 16 million observations/year
  - Data transmitted in near real time every hour for most stations
- Snow courses = 1 measurement/month SWE and depth
- SNOTEL = 720 transmissions/month of multiple sensors
- Safety

http://www.wcc.nrcs.usda.gov/snow/
SNOTEL Site - Augmented Data Array

- Snow water content
- Precipitation
- Temperature
- Snow depth
- Relative humidity
- Wind speed/direction
- Solar radiation
- Soil moisture / temperature
Berthoud Summit (335) Colorado SNOTEL Site - 11300 ft

- Air Temperature Average (degF)
- Air Temperature Maximum (degF)
- Air Temperature Minimum (degF)
Mountain Snowpack as of February 1, 2015

Percent of
1981-2010 Median (US)
1981-2010 Average (Canada)
- > 180
- 150 - 180
- 130 - 150
- 110 - 130
- 90 - 110
- 70 - 90
- 50 - 70
- 25 - 50
- < 25

Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Feb 10, 2015

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median

Unavailable
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 145%
- > 150%

Prepared by:
USDA Natural Resources Conservation Service
National Water and Climate Center
Portland, Oregon
http://www.nwcrc.usda.gov
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Spring and Summer Streamflow Forecasts as of February 1, 2015

Percent of 1981-2010 Average

- > 180
- 150 - 180
- 130 - 149
- 110 - 129
- 90 - 109
- 70 - 89
- 50 - 69
- 25 - 49
- < 25

No forecasts until March

50% exceedance probability forecasts shown. For forecasts at other exceedance probabilities, see individual state reports.

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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

- [www.wcc.nrcs.usda.gov/scan/](http://www.wcc.nrcs.usda.gov/scan/)
Johnson Farm, Nebraska
SCAN Site
Future Directions

- Further automating of manual snow courses to SNOTEL sites where real-time information is needed to provide water supply forecasts.
- Expansion of SCAN to provide governments, water managers, agricultural producers, businesses and researchers improved information about soil moisture conditions and potential droughts.
- Improving models and computational capacity to provide more frequent and accurate water supply forecasts and assessments of soil moisture.
- Development of simulation modeling capabilities to compliment statistical modeling efforts.
Application of a Physically-Based Distribution Snowmelt and Streamflow Simulation Model in Support of NRCS Water Supply Forecasting

- Develop protocol for distributed model forcing data
- Real-time simulation of snow deposition, melt, and surface water input
- Streamflow simulation
- Application to other basins
- Effects of a warming climate on snow accumulation and melt patterns
Water Balance Modeling

- Soil Ecohydrology Model (SEM) effort with Mark Weltz and Mark Seyfried. Taking a rangeland water balance – plant growth model and hooking it to the data stream that is derived from SNOTEL, SCAN, and RAWS weather stations to allow for real-time tracking of soil moisture and plant growth for on-going drought assessments by modeling interactions of PPT and soil water content (either measured or estimated) / and plant growth.
Potential ARS/NRCS Collaboration

• Soil moisture tools
• Soil moisture trend analysis
• Snowpack trend analysis
• Impacts of climate change on snowmelt/runoff timing
• National Soil Moisture Network
Potential ARS/NRCS Collaboration

• **Fluidless SWE (Snow SCALE) analysis**: Fluidless vs. Fluid. - Determine and quantify differences in measurements. Evaluate performance and recommend design improvements to improve data quality.

• **Design a fluidless precipitation gage**: Design all-season fluidless gage to measure precipitation with minimal power requirements.
Potential ARS/NRCS Collaboration

- **Field note software for snow surveys:** Design software to use with tablet to take field notes and automatically load notes into NRCS database.

- **Metadata database for SNOTEL/SCAN/Snow Survey stations:** Enhance and redesign current Access database using database software to incorporate metadata of stations for access using NRCS web tools.
Potential ARS/NRCS Collaboration

• **Soil Moisture – Temperature network evaluation:** Analysis of existing soil moisture/temperature network and determine priority areas for expansion of data for better special analysis for watershed management nationwide. Focus primarily on larger watersheds such as Missouri basin, Arkansas, etc.

• **SNOTEL air temperature analysis** – determine best ways to remove bias in temperature data that is a result of changes made with sensors, algorithms, sensor locations and electronics.
Initiatives/new efforts

• Interactive map development – Expand and refine interactive point map indicating current climatological and hydrologic conditions for data sites in the NWCC database.
Initiatives/new efforts

• Data quality - Develop a tool to ingest and analyze the Oregon State PRISM group’s quality-controlled SNOTEL ("PRISM-QC") data which was developed under a previous initiative.
Initiatives/new efforts

• Modeling - Continue development of VIPER as our main forecasting tool. Produce a centralized forecast system that allows for a more complete interaction with the NWCC database, ensuring consistent data use and improved storage of forecast information.