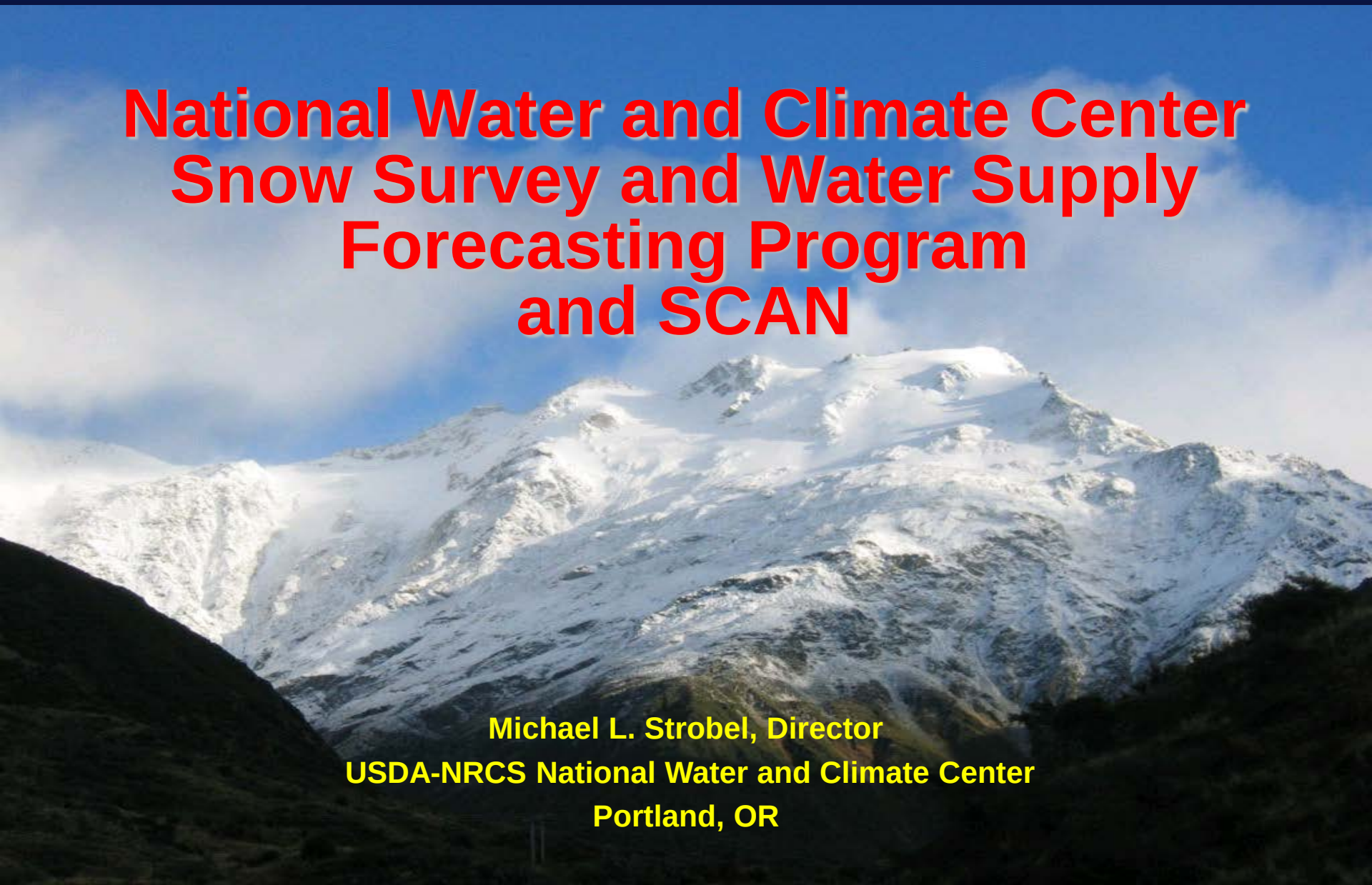
United States Department of Agriculture
Natural Resources Conservation Service

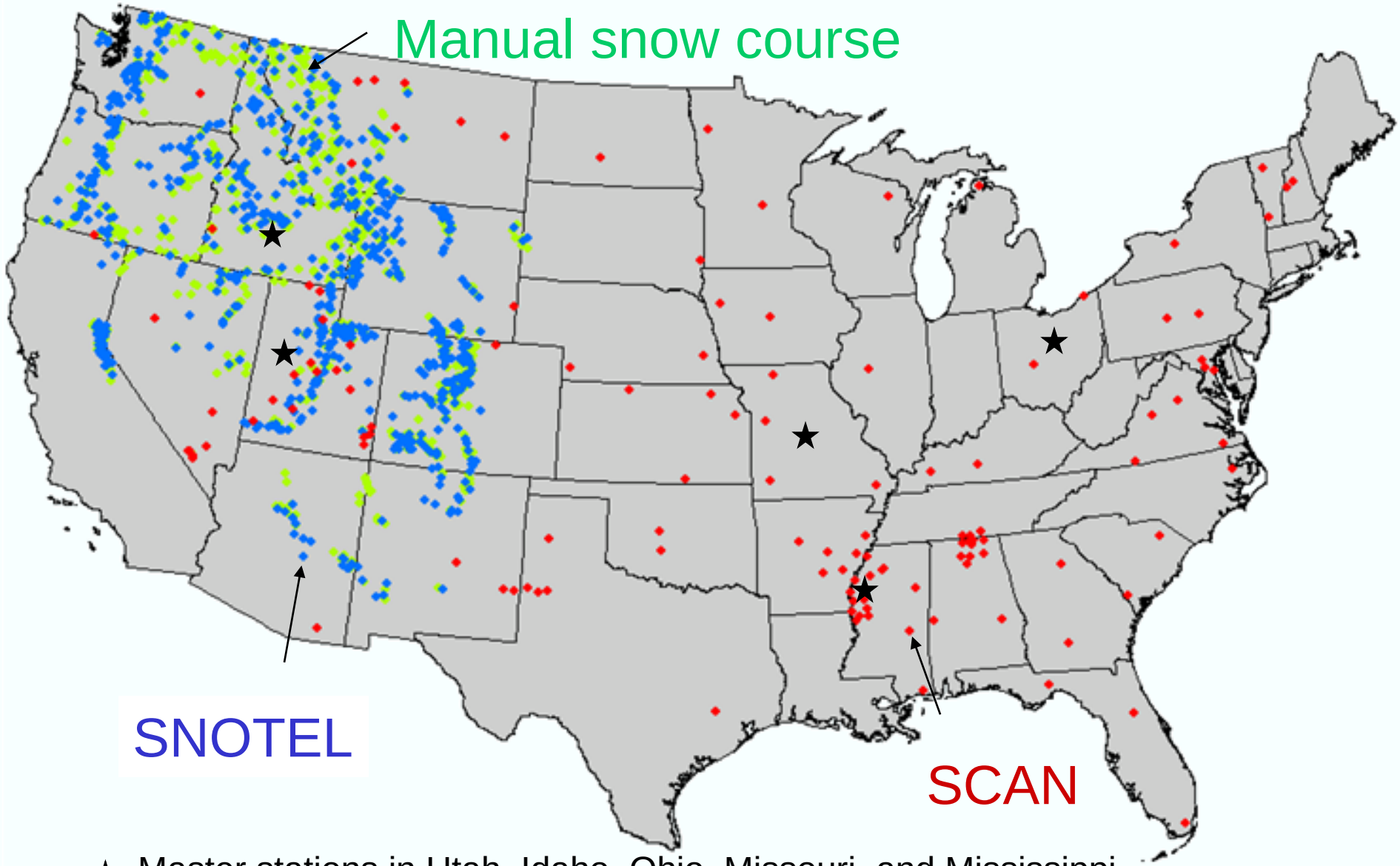


National Water and Climate Center Snow Survey and Water Supply Forecasting Program and SCAN

Michael L. Strobel, Director
USDA-NRCS National Water and Climate Center
Portland, OR

United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS



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

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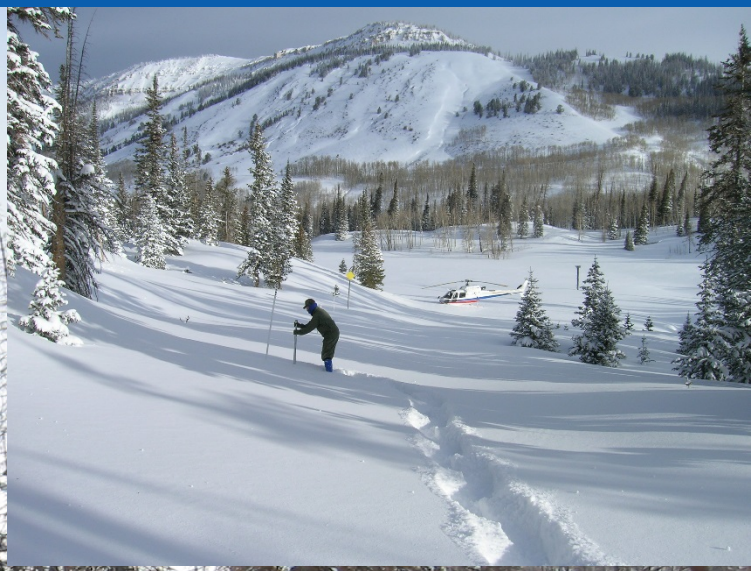


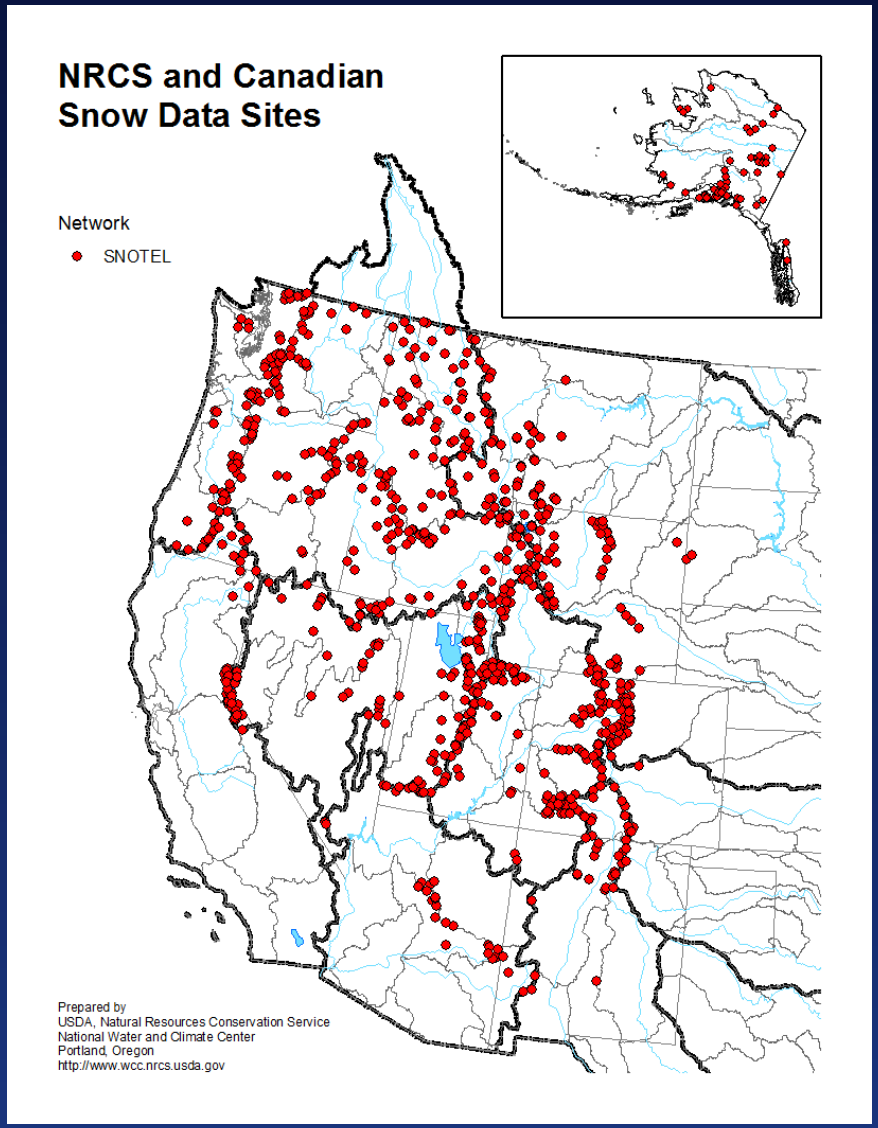
Manual Snow Surveys

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

+300,000 snow course measurements to date

NRCS SNOTEL Network

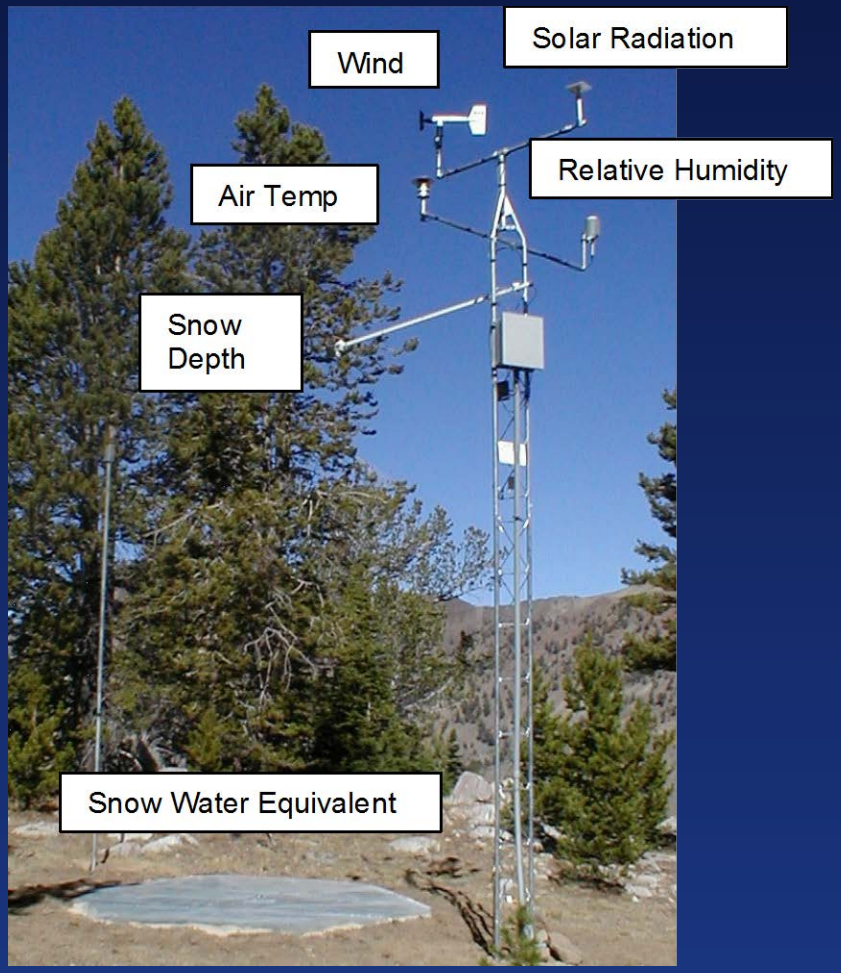
- SNOTEL network
  - 13 Western States
  - 885 sites (includes SnoLite)
  - More than 16 million observations/year
  - Data transmitted in near real time every hour for most stations
- Snow courses = 1 measurement/ month SWE and depth
- SNOTEL = 720 transmissions/month of multiple sensors
- Safety



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**



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Report Generator 1.3

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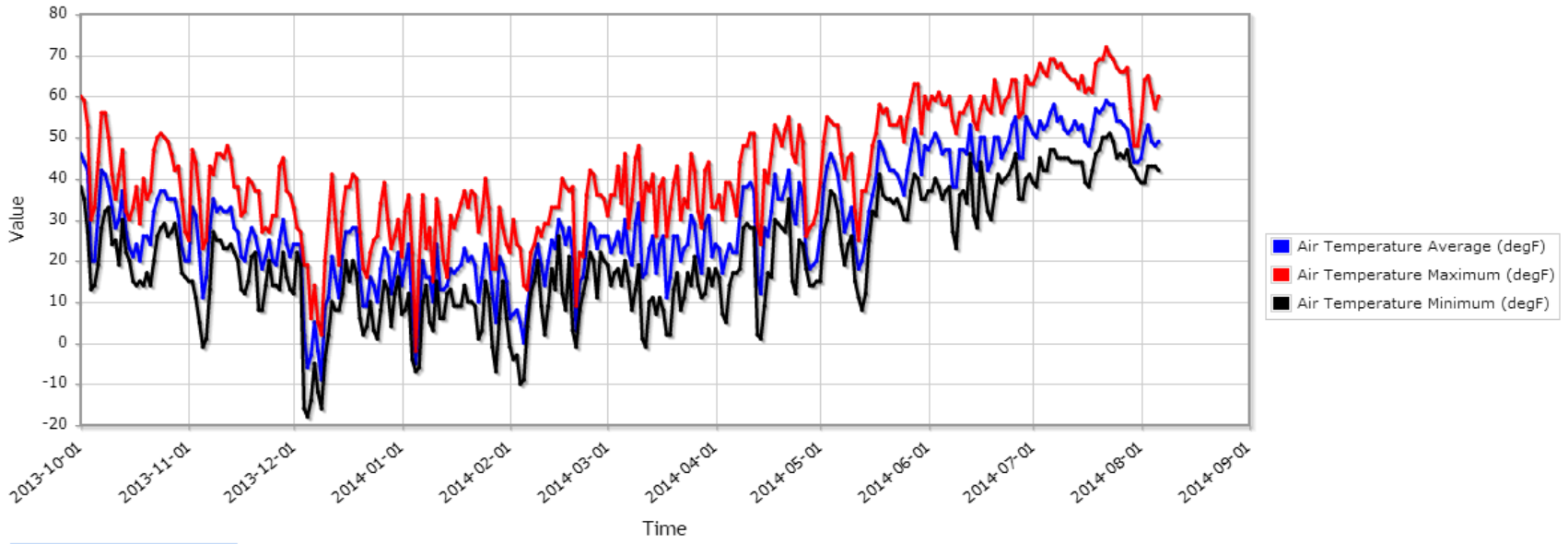
View Station Information

Create/Modify Report | View Report

Output Format | Layout | Units | Time Period | Fit Chart To Screen

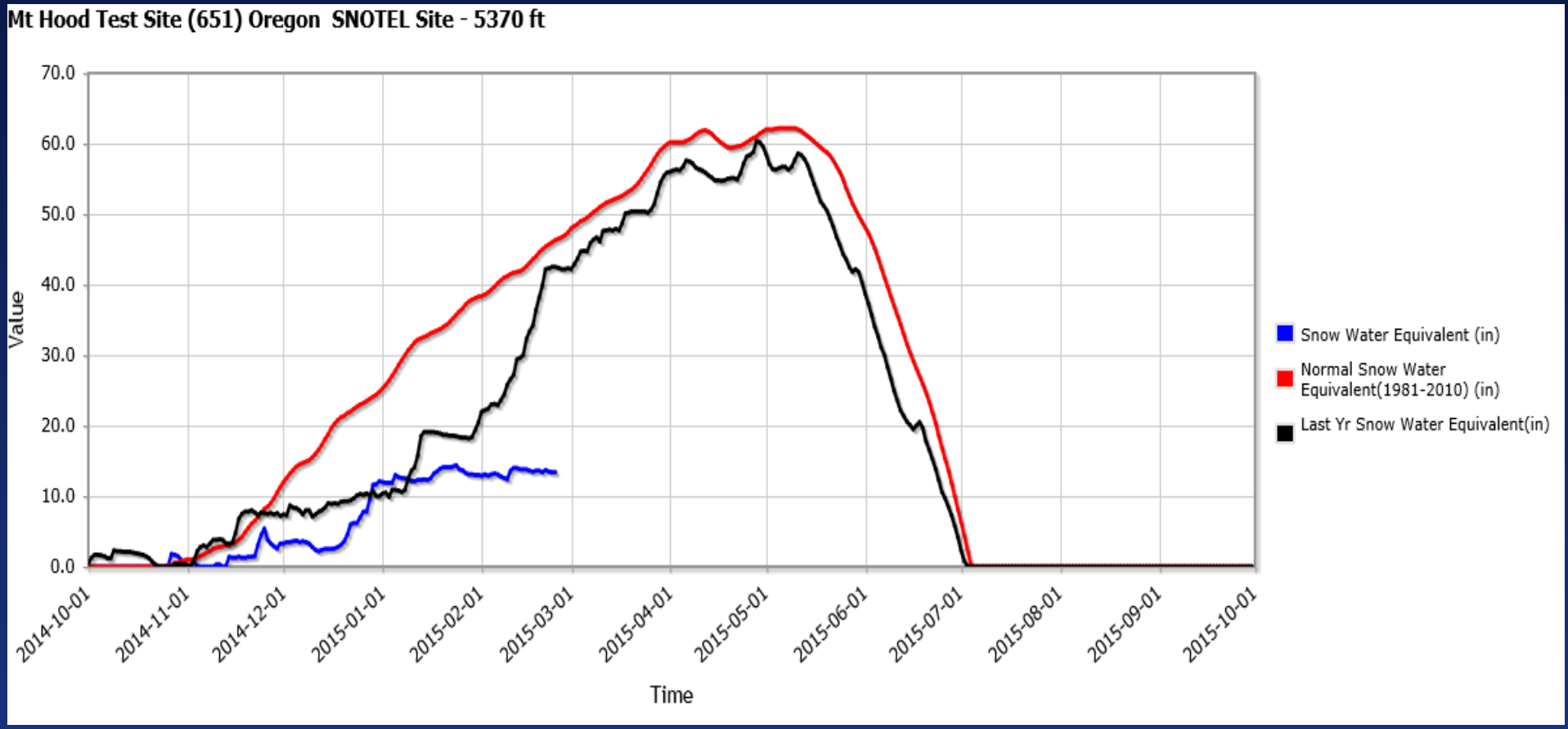
Chart Help

Berthoud Summit (335) Colorado SNOTEL Site - 11300 ft



Export Chart As Image

Generated on 08/07/14 13:26:05


Mt Hood Test Site (651) Oregon SNOTEL Site - 5370 ft
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Value
2014-10-01
2014-11-01
2014-12-01
2015-01-01
2015-02-01
2015-03-01
2015-04-01
2015-05-01
2015-06-01
2015-07-01
2015-08-01
2015-09-01
2015-10-01
Time
Snow Water Equivalent (in)
Normal Snow Water Equivalent(1981-2010) (in)
Last Yr Snow Water Equivalent(in)

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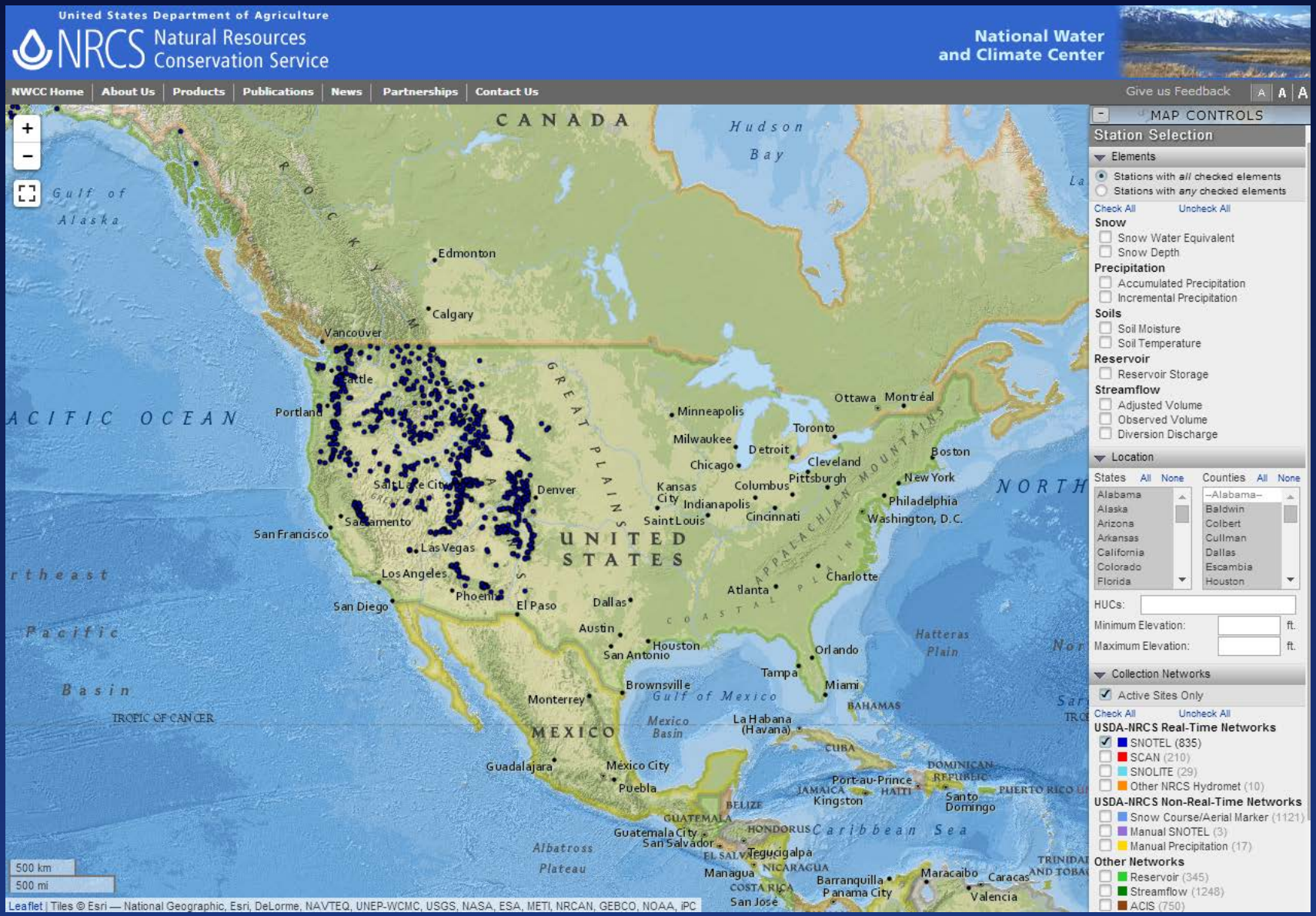
Natural Resources Conservation Service



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A A A

Report Generator 1.3

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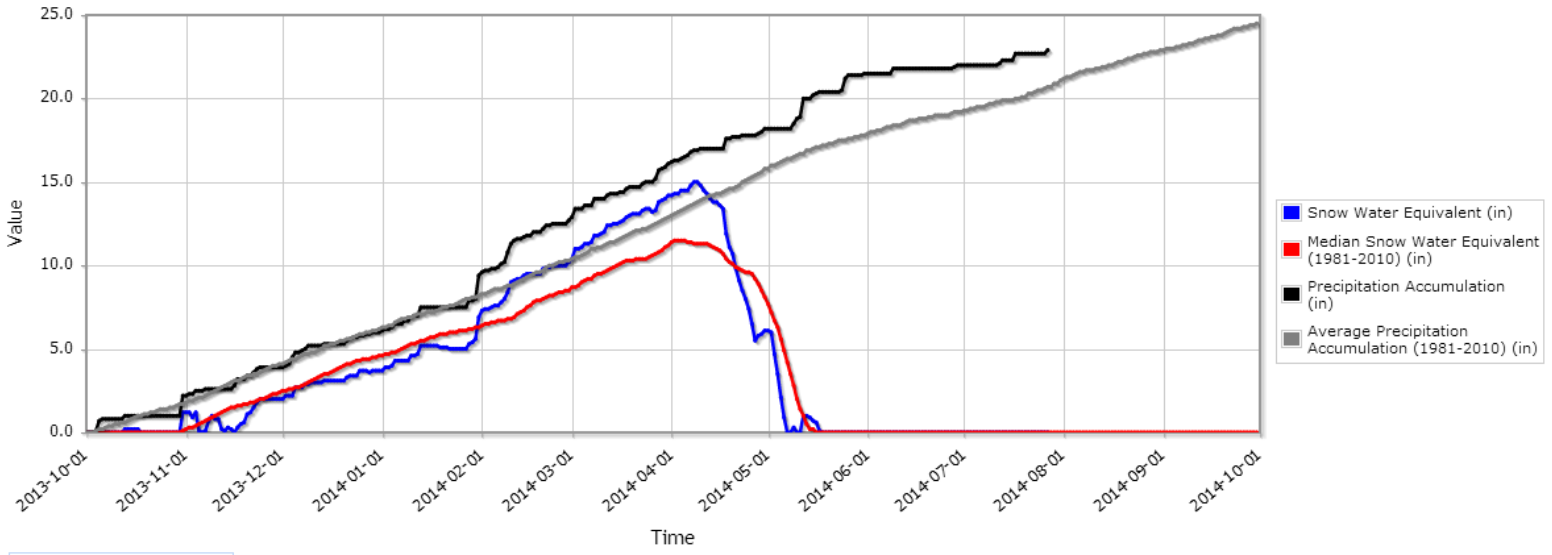
Chart Help

Summit Ranch (802) Colorado SNOTEL Site - 9400 ft



Export Chart As Image

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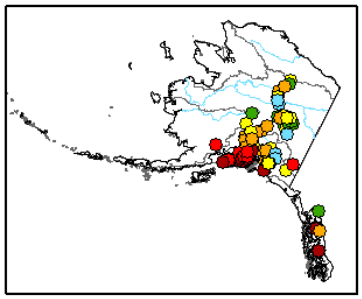
Mountain Snowpack as of February 1, 2015



Percent of
1981-2010 Median (US)
1981-2010 Average (Canada)

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

Prepared by:
USDA Natural Resources Conservation Service
National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov
Created: 4 Feb 2015 10:44

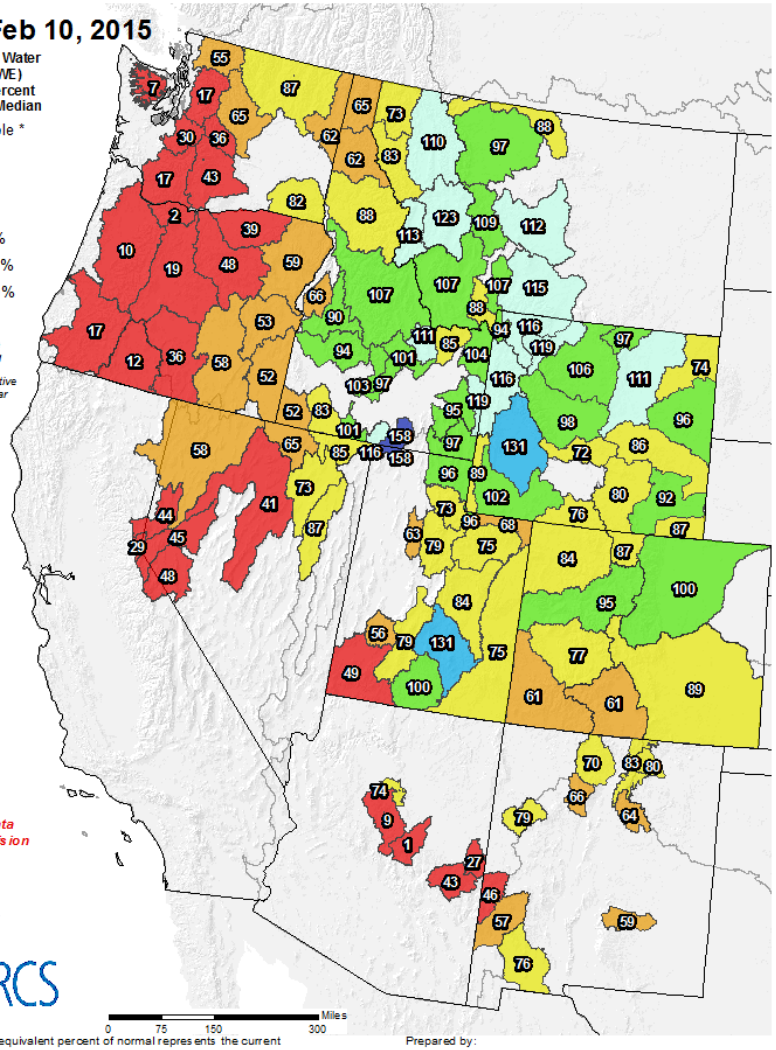
Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal

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 - 149%
- >= 150%

* Data unavailable at time of posting or measurement is not representative at this time of year



Provisional data subject to revision

USDA NRCS

0 75 150 300 Miles

The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
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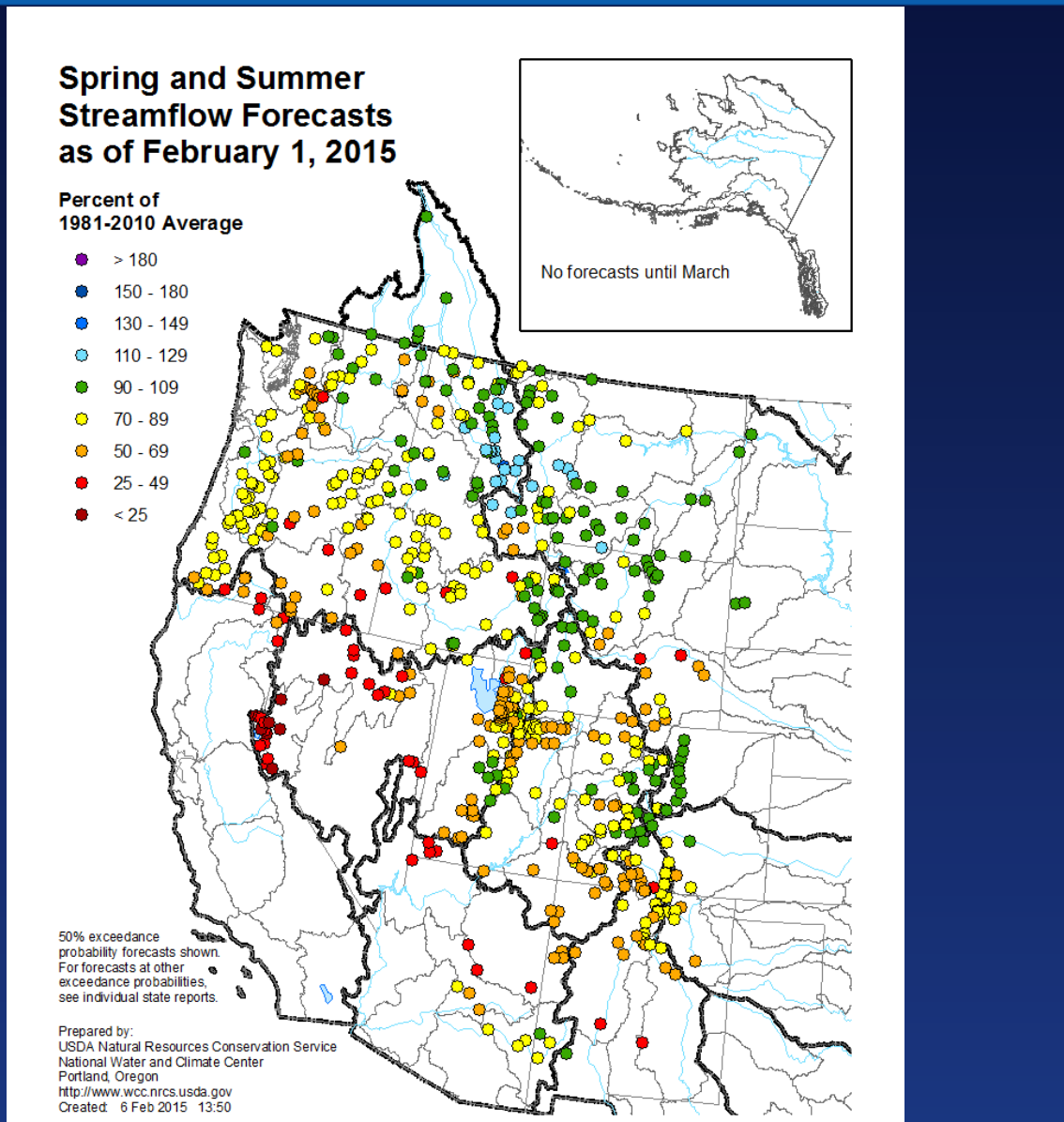
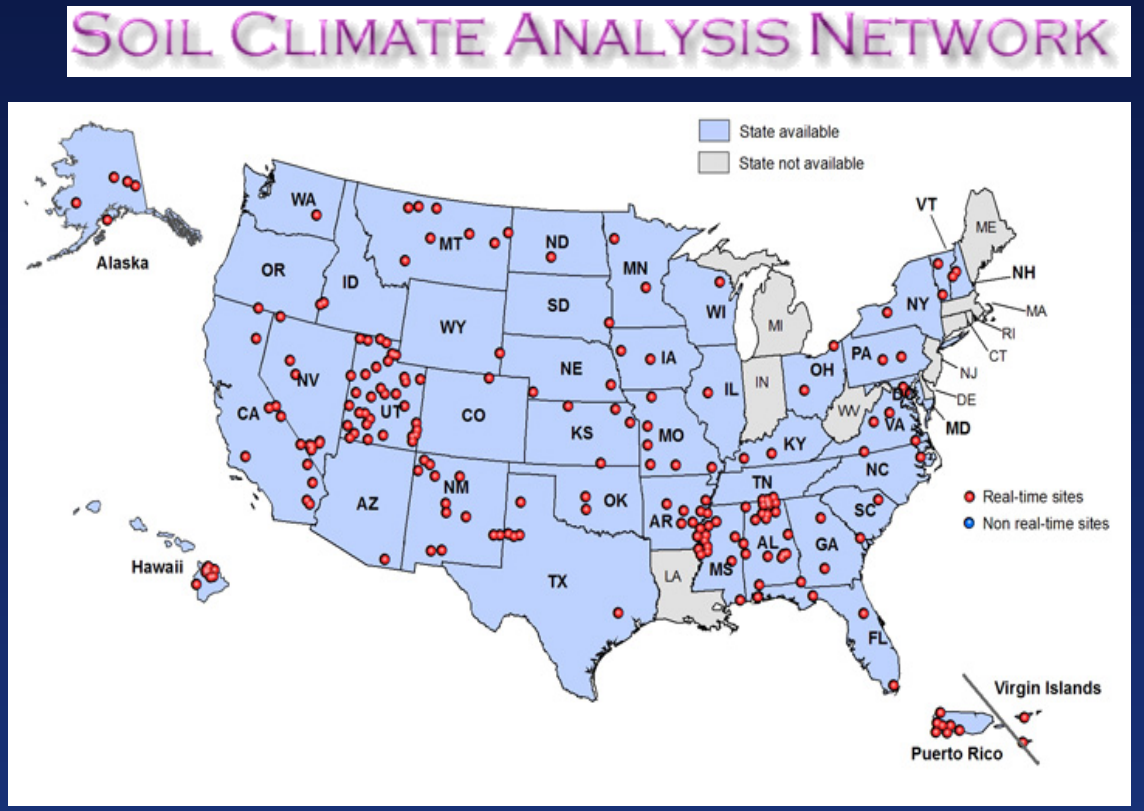
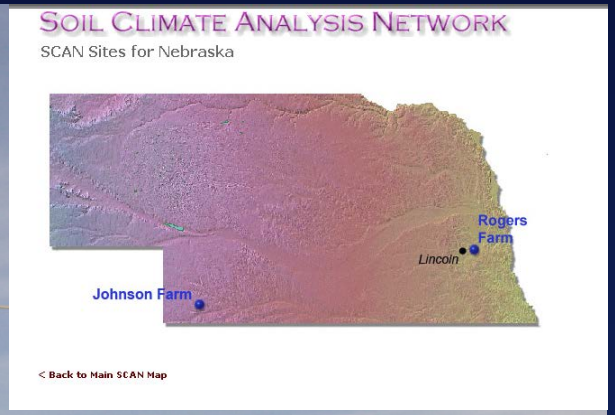

Spring and Summer
Streamflow Forecasts
as of February 1, 2015
Percent of
1981-2010 Average
> 180
150 - 180
130 - 149
110 - 129
90 - 109
70 - 89
50 - 69
25 - 49
< 25
No forecasts until March
50% exceedance
probability forecasts shown.
For forecasts at other
exceedance probabilities,
see individual state reports.
Prepared by:
USDA Natural Resources Conservation Service
National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov
Created: 6 Feb 2015 13:50

Soil Climate Analysis Network

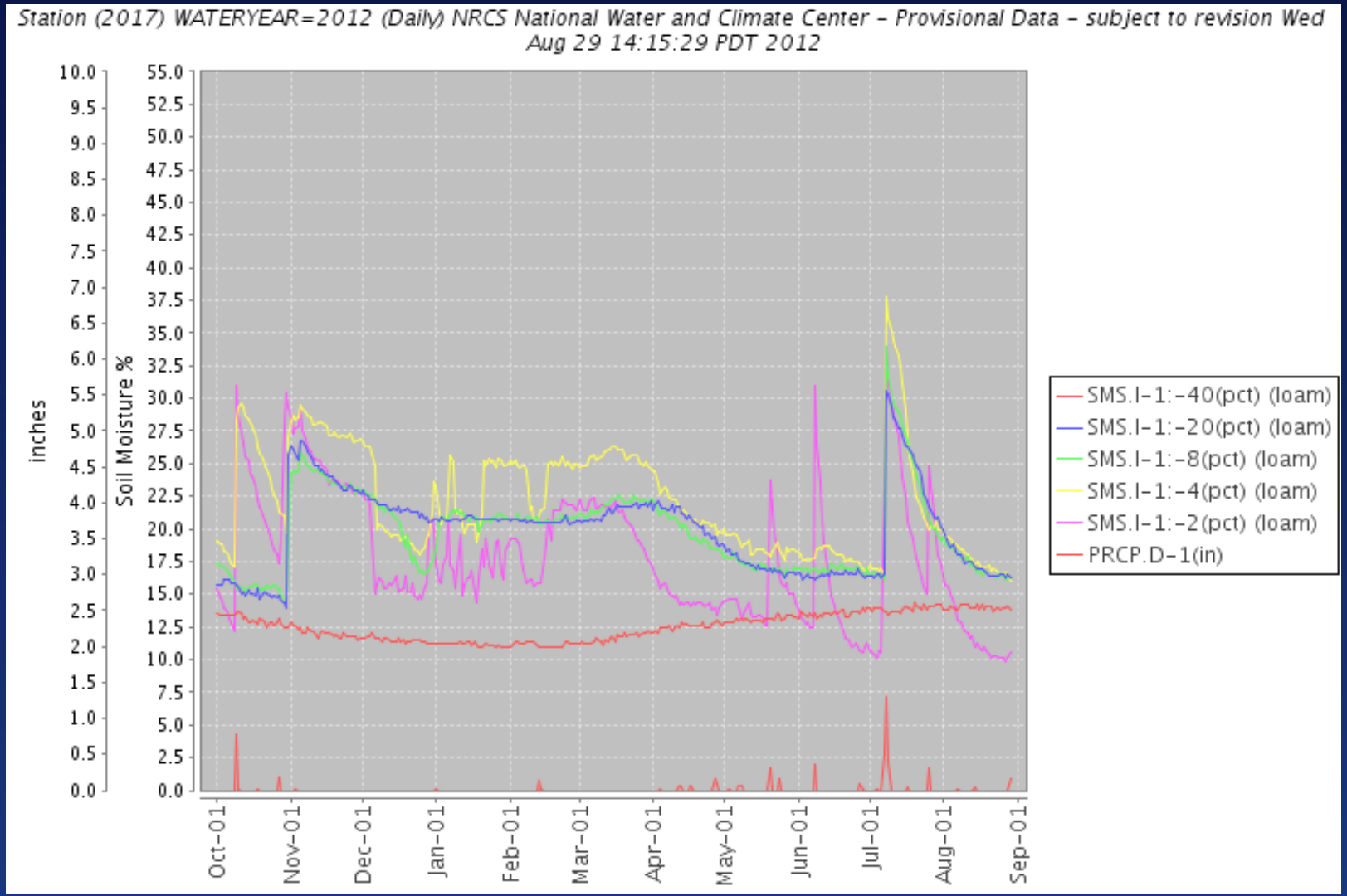
- **SCAN** (Soil Climate Analysis Network)
  - 221 sites in 40 States and US Territories
  - Soil-climate monitoring
  - Uses meteor burst telemetry
  - Critical for drought monitoring
- www.wcc.nrcs.usda.gov/scan/



Johnson Farm, Nebraska SCAN Site



SCAN Data Plot



Colorado SCAN Site NUNN

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.