

2015: Lake Tahoe's Lowest Snow in a Century of Measurement

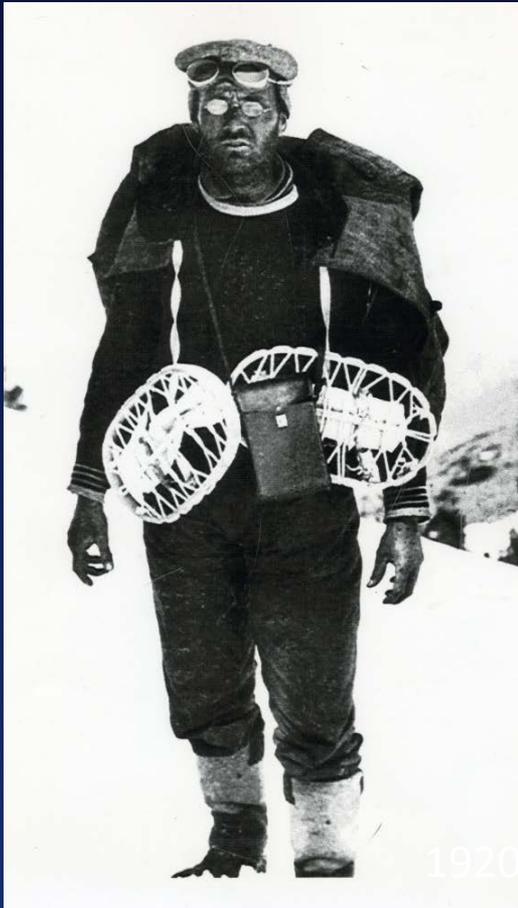
Jeff Anderson, Hydrologist

NRCS Snow Survey and Water Supply Forecasting Program

Tahoe Science Conference

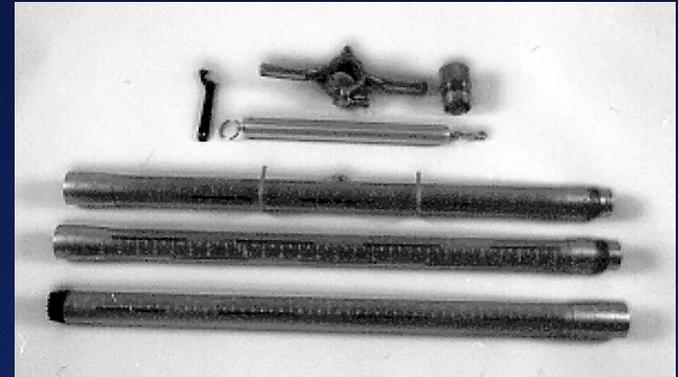
September 23, 2015

03/27/2015

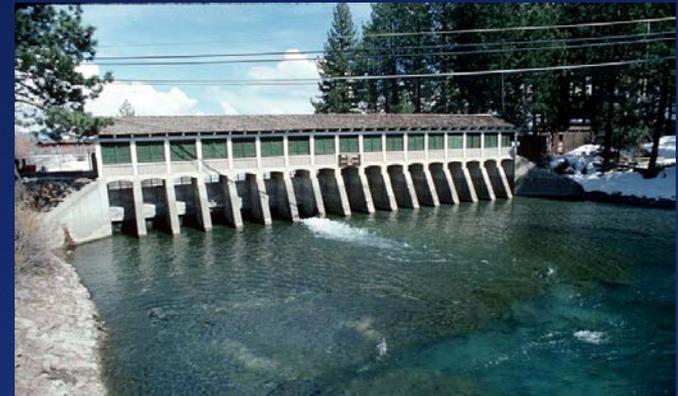


Father of Snow Survey
Dr. James E. Church
Classics Professor
University of Nevada, Reno

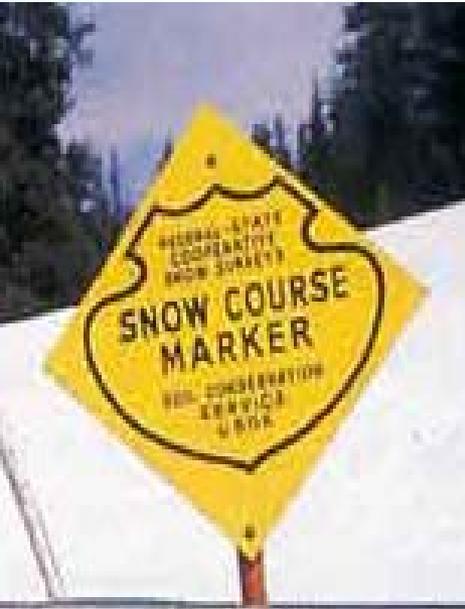
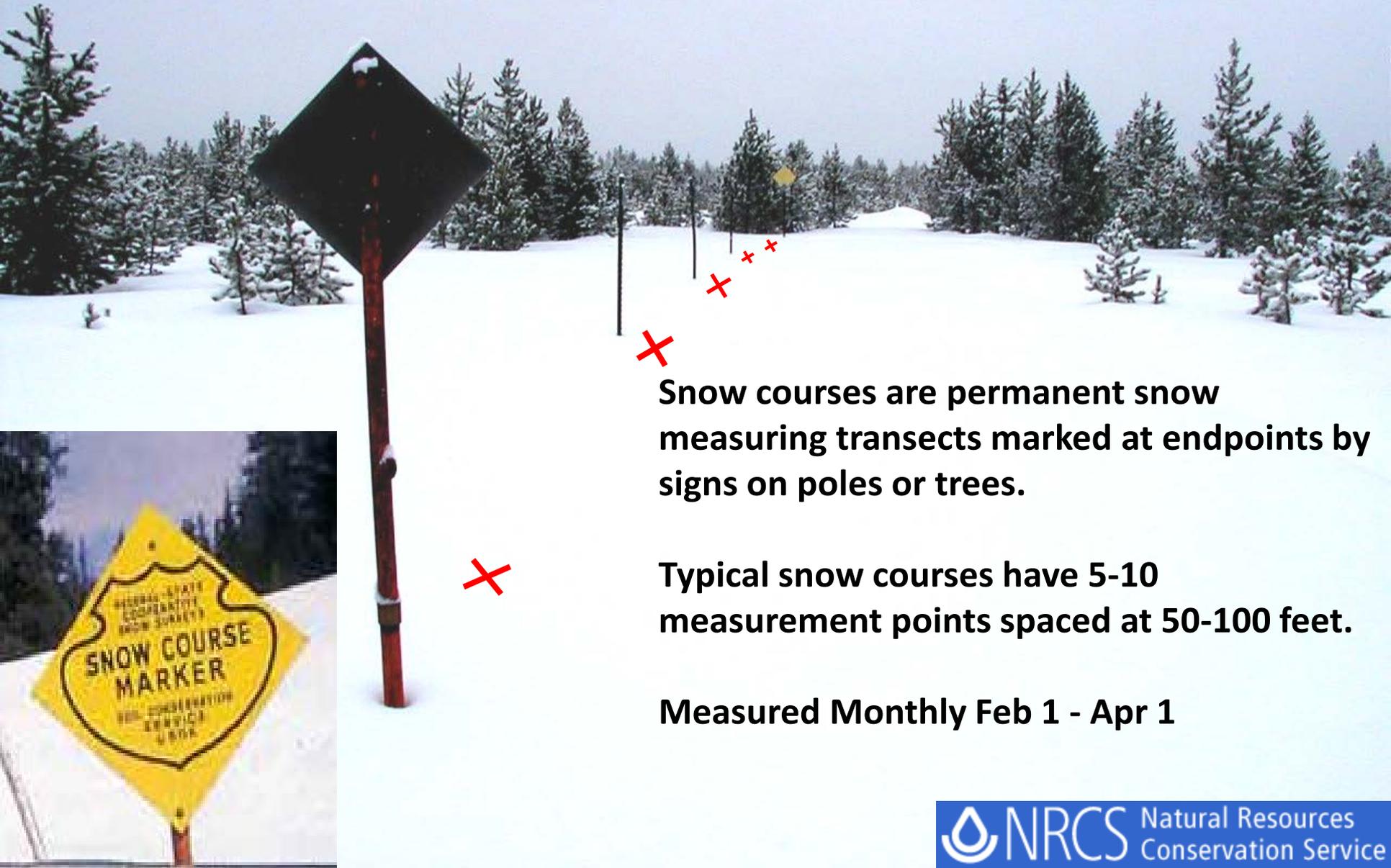
Invented
Mt Rose Sampler
1908-1909



First Western
Water Supply Forecasts
Lake Tahoe Rise
1910



Snow Course



Snow courses are permanent snow measuring transects marked at endpoints by signs on poles or trees.

Typical snow courses have 5-10 measurement points spaced at 50-100 feet.

Measured Monthly Feb 1 - Apr 1

25 ft between points

Mont

SNOW SURVEY OF MOUNT ROSE, APRIL 1913

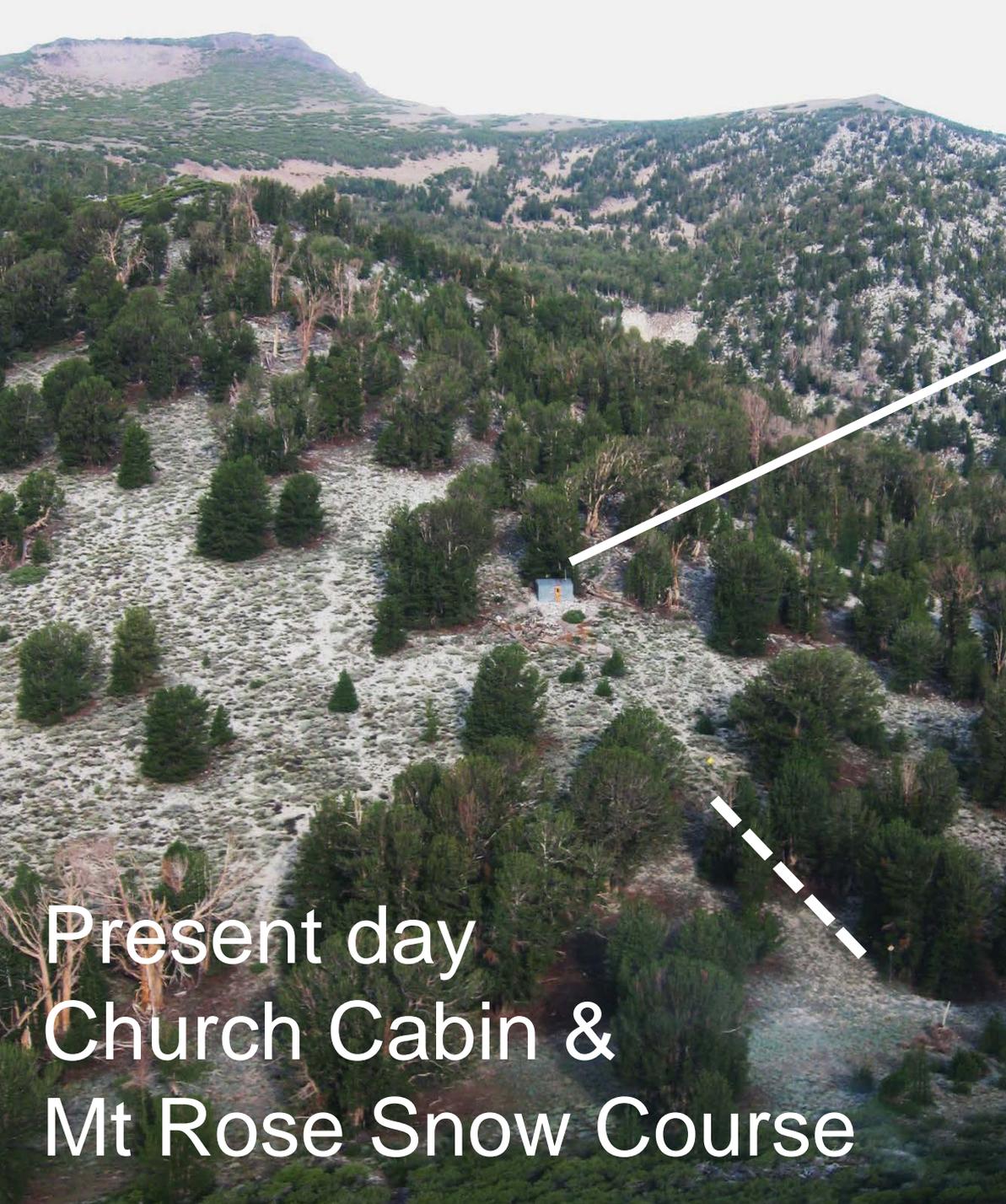
DEPTH OF SNOW CONTACT	WATER CONTENT IN INCHES	PERCENT OF CONTENT	DEPTH OF SNOW CONTACT	WATER CONTENT IN INCHES	PERCENT OF CONTENT	DEPTH OF SNOW CONTACT	WATER CONTENT IN INCHES	PERCENT OF CONTENT
28"	10.1		23.6	9.1		15.5	6.7	
60.3"	19.8		29.7	11.4		32.7	22.8	
69.9	29.8		29.7	11.4		34.1	36.2	
78.9	32.1		10.2	2.6		23.5	23.0	
80.6	33.2		25.5	8.4		70.1	23.5	
50	17.1		23.4	8.0		19.7	6.3	
58.6	22.9		27.6	9		18.5	7.9	
37.7	13.4		27.6	9		50.5	21	
33.5	11.9		63.4	24.3		73.6	36.4	
26.5	9.7		8.6	2.7		68.7	29.8	
39	14.7		29.2	7.8		19	4.8	
18.4	5.4		39	15.4		4.5	1.5	
48.6"	18.2	37.5%	37.1	10.2		1.5	0.8	
KENNEDY PASS TO WEST POINT PASS			49	18.3		1.2	0.7	
100' APART			9.5	2.2		1.0	0.3	
0	0		13	2.6		1.3	0.4	
39.6	15.3		8.6	3.1		7.5	2.4	
45.6	16.8		2.8	1.0		1.0	0.4	
60.3	25.8		37.8	11.3		21	5.7	
23.6	7.8		34.2	12.6		13.3	4.2	
12	0.3		4.9	1.3		7	1.2	
26.7	0.1		15.2	6.0		3.5	1.1	
78.1	32.2		0	0		1.2	0.3	
24.1	7.2		0	0		0	0	
23.7	6.8		0	0		0	0	
49.7	14.2		11.5	4.6		19.5	6.8	
54.5	18.9		15.3	5.7		0	0.5	
11.6	3.3		33.4	11.8		3.5	1.2	
33.1	38.7		0.1	2.8		2.0	0.5	
25.2	7.2		1.8	0.6		12.7	3.7	
7.5	2.4		11.3	3.4		33.5	12.7	
39.6	13.0		0	0		60	25.6	
24.2	7.3		27.0"	9.6"	35.5%	17.7	5.7	
9.3	2.3		Mont to B.H.			11.6	3.4	
52.8	21.2		105.8	48.9		5.3	2.2	
70.3	31.9		61.8	24.1		14.5	4.1	
17.5	6.2		108.8	44.8		36.3	11.2	
55.1	22.1		143.8	62.2		71.7	23.1	
27.0	5.6		144.7	64.8		30	10.2	
			97.1	40.8		95.6	41.0	
			21.5	14.0		37.5	23.8	
			28.2	10.3		51.7	19.4	
						42.7	20	
						42.4	16.1	
						34.5	12.2	
						106.5	51.6	

The original Mt. Rose snow course consisted of over 1000 sample points.

By 1913, (shown here) it had been reduced to 153 points.

Today it has 5 points.





Present day
Church Cabin &
Mt Rose Snow Course

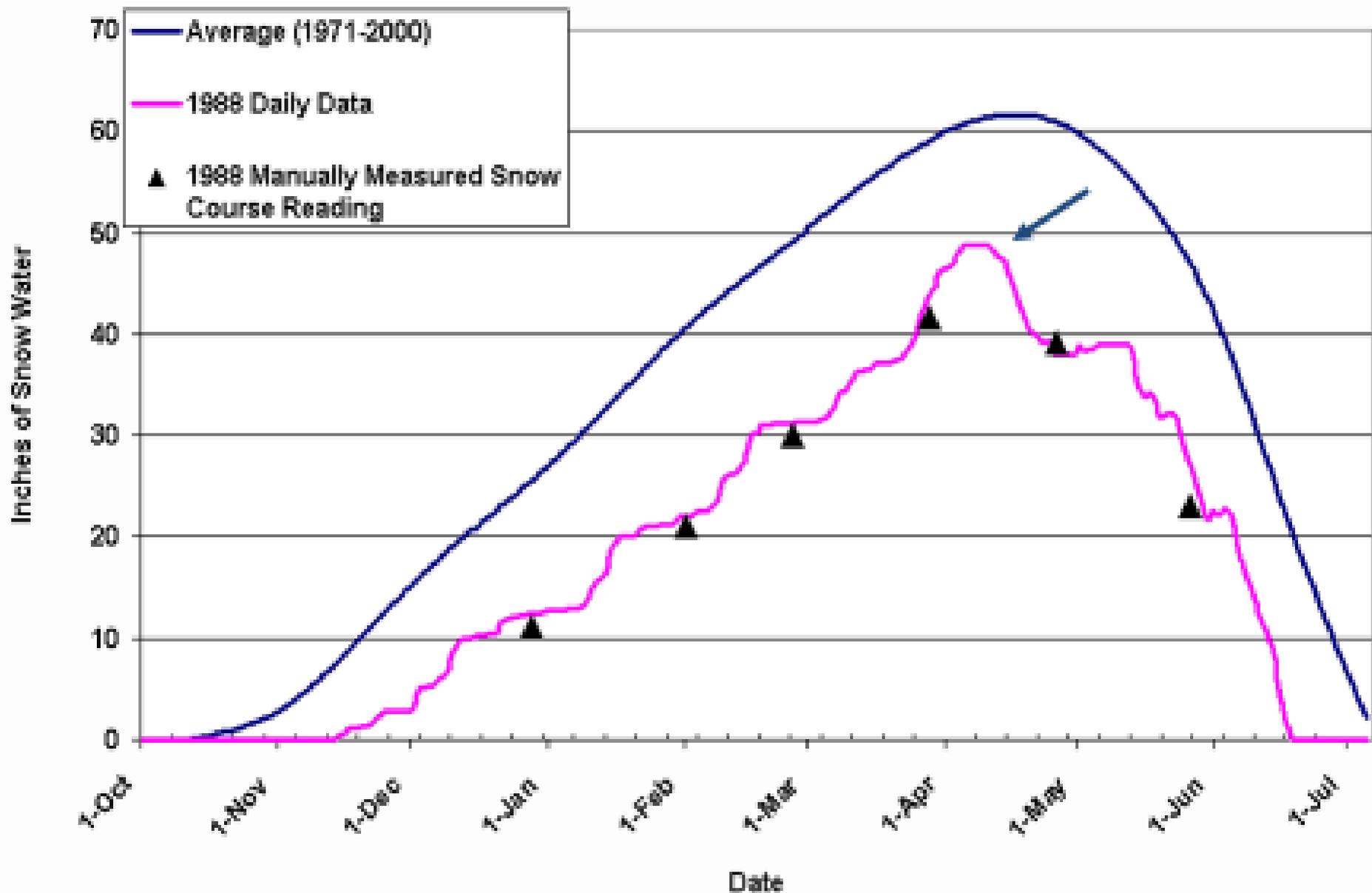




1936 the Federal Gov't takes the lead (except in CA)
+300,000 snow course measurements to date

SNOTEL “Snow Telemetry”





Lake Tahoe Basin

16 Active Snow
Measurement
Stations

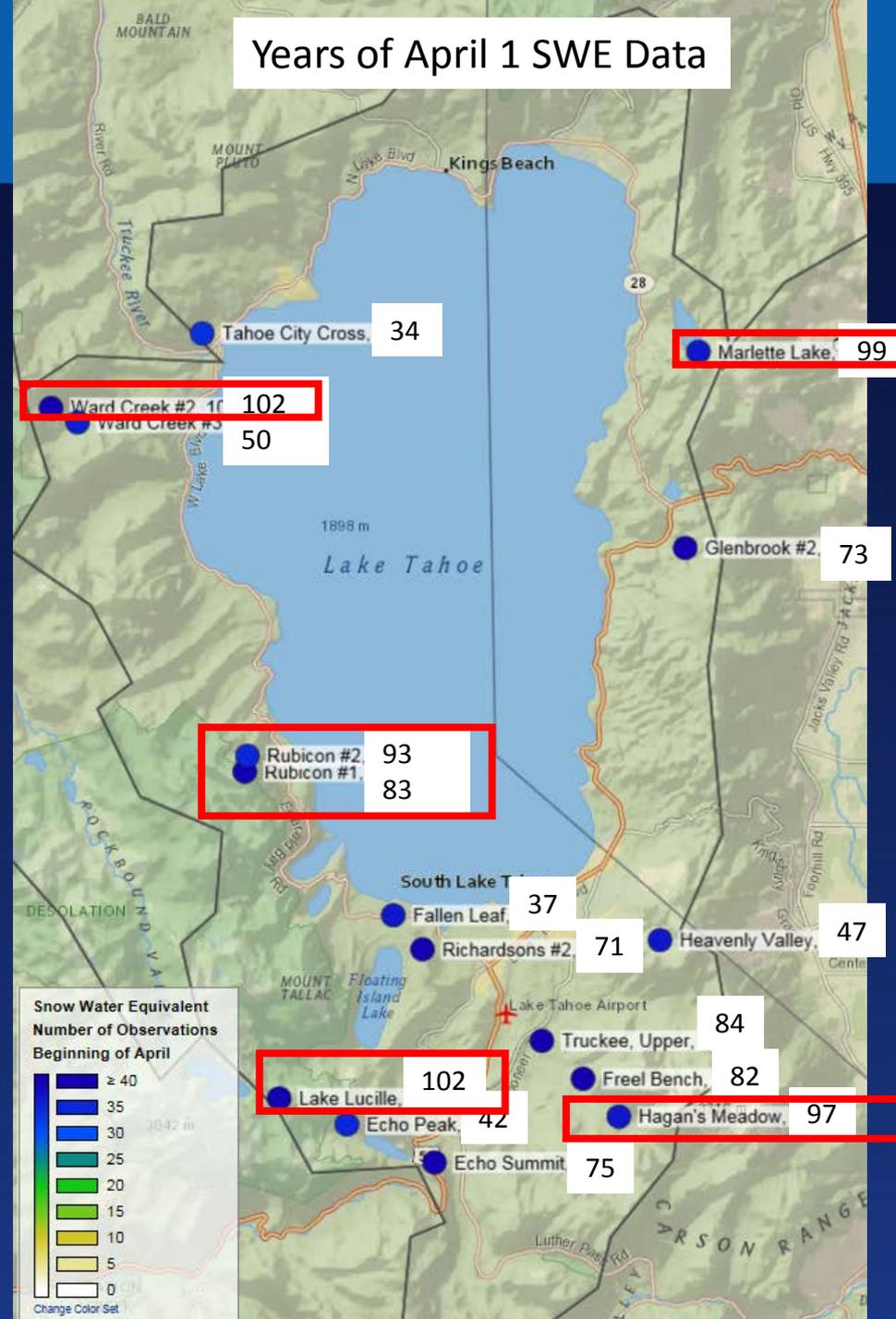
8 SNOTEL

8 Snow Course
Aerial Marker

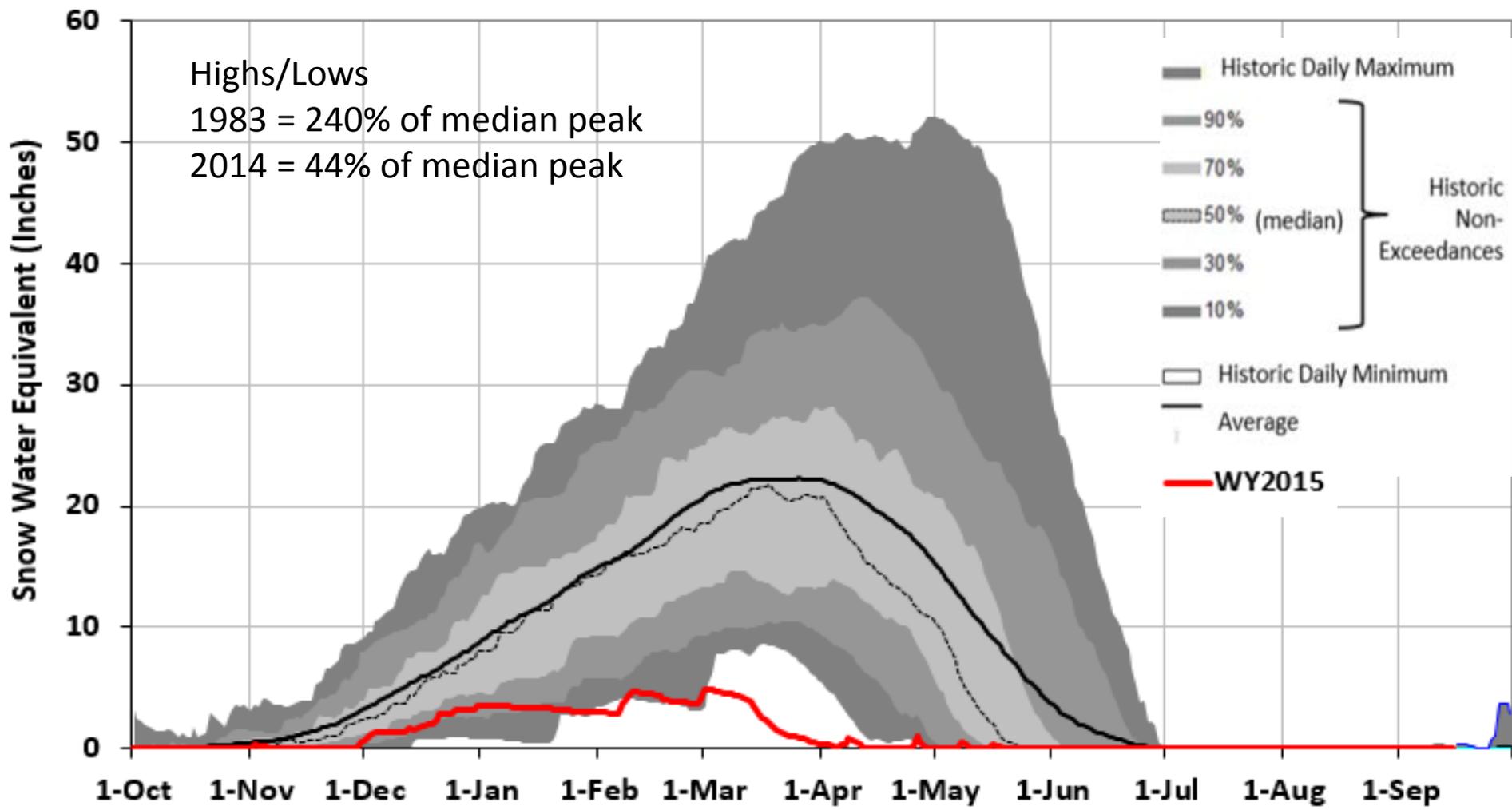


6 sites have data records that
start between 1910 and 1916

No other watershed in the US
has a better snow water
dataset



Lake Tahoe Basin Historic Non-Exceedence SNOTEL Data for 1981-2014 for 8 Stations





Richardson #2 6,553ft



Upper Truckee 6,396ft

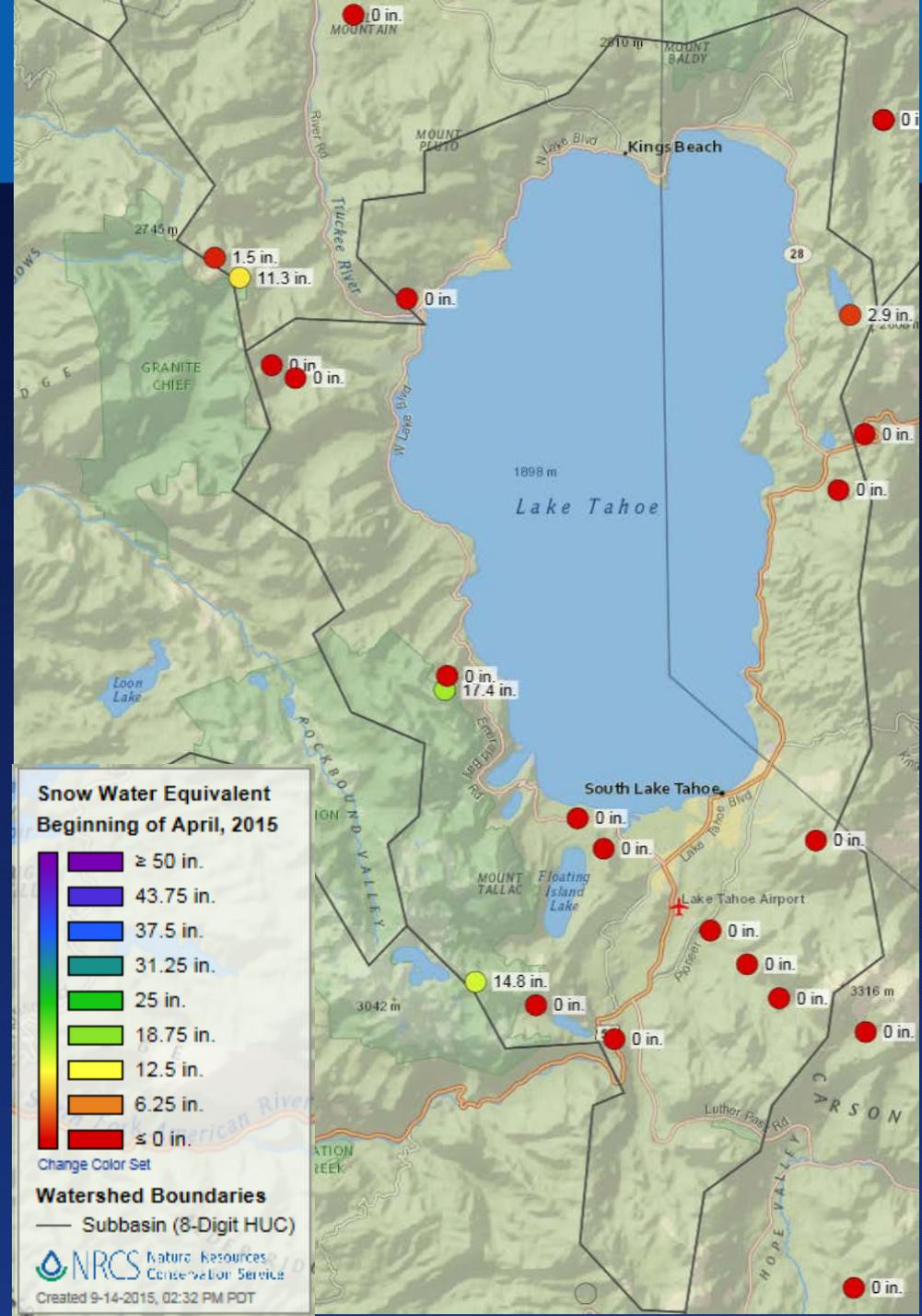
Below 6500 ft snow courses were snow free on Feb 1, Mar 1 and Apr 1.
First time these two courses had no snow going back to 1944 when records begin.

United States Department of Agriculture
Natural Resources Conservation Service

13 of 16 sites within the Lake
Tahoe Basin were snow free on
April 1, 2015

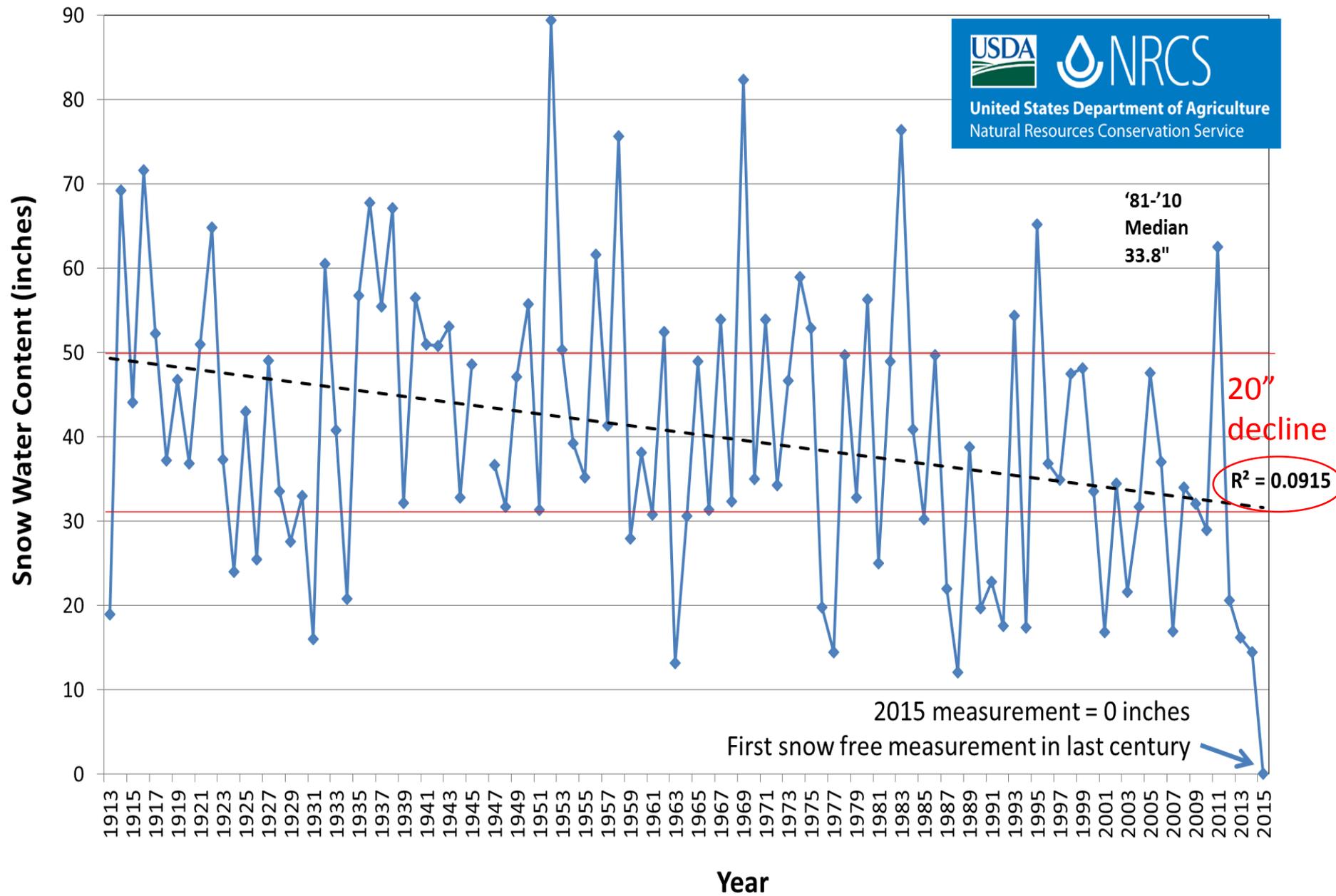
Of these, 7 were snow free for
the first time.

In an average year only Fallen
Leaf SNOTEL would be snow
free.



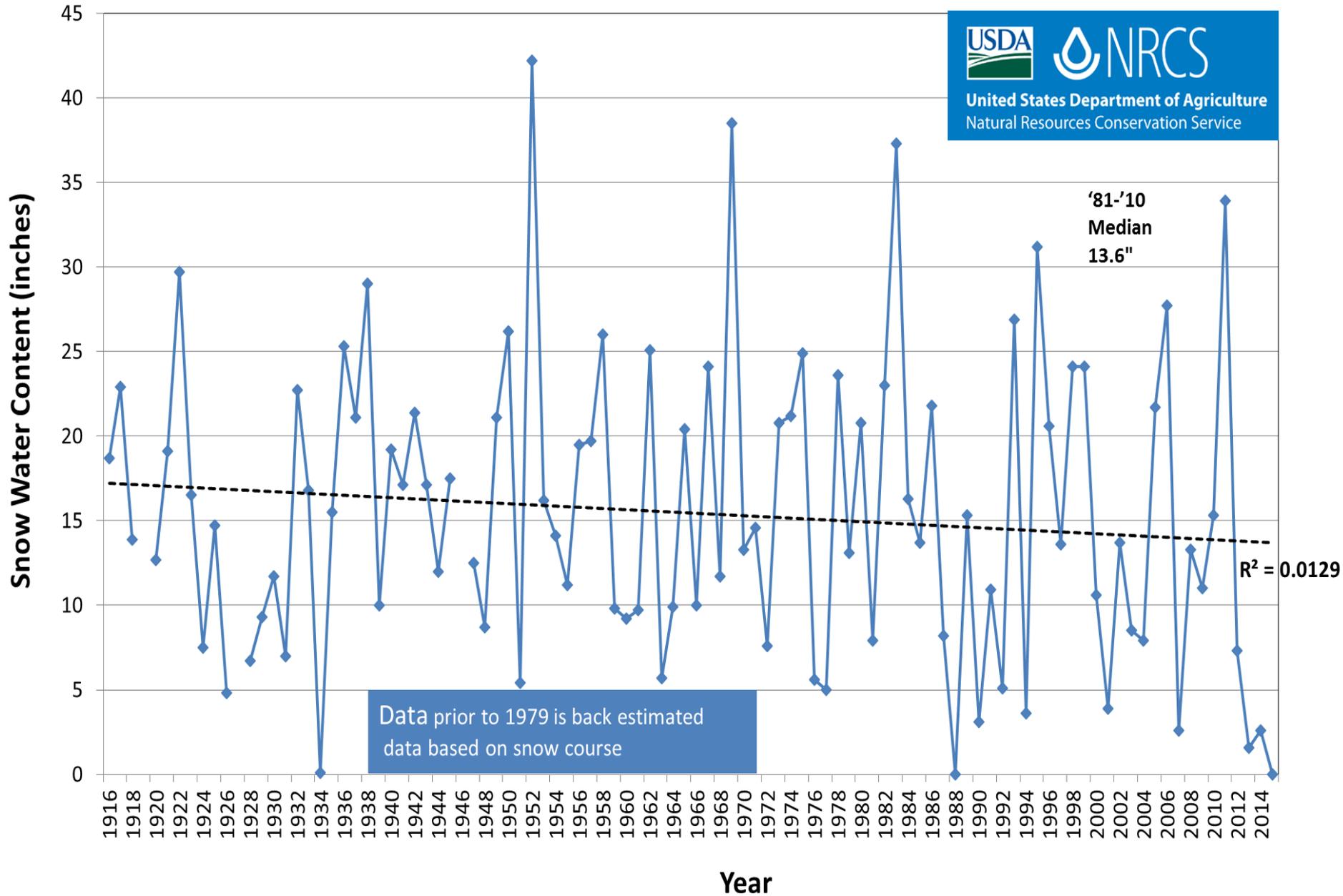
Ward Creek #2 Snow Course, Lake Tahoe Basin, 7100ft

April 1 Snow Water Content for Years 1913-2015



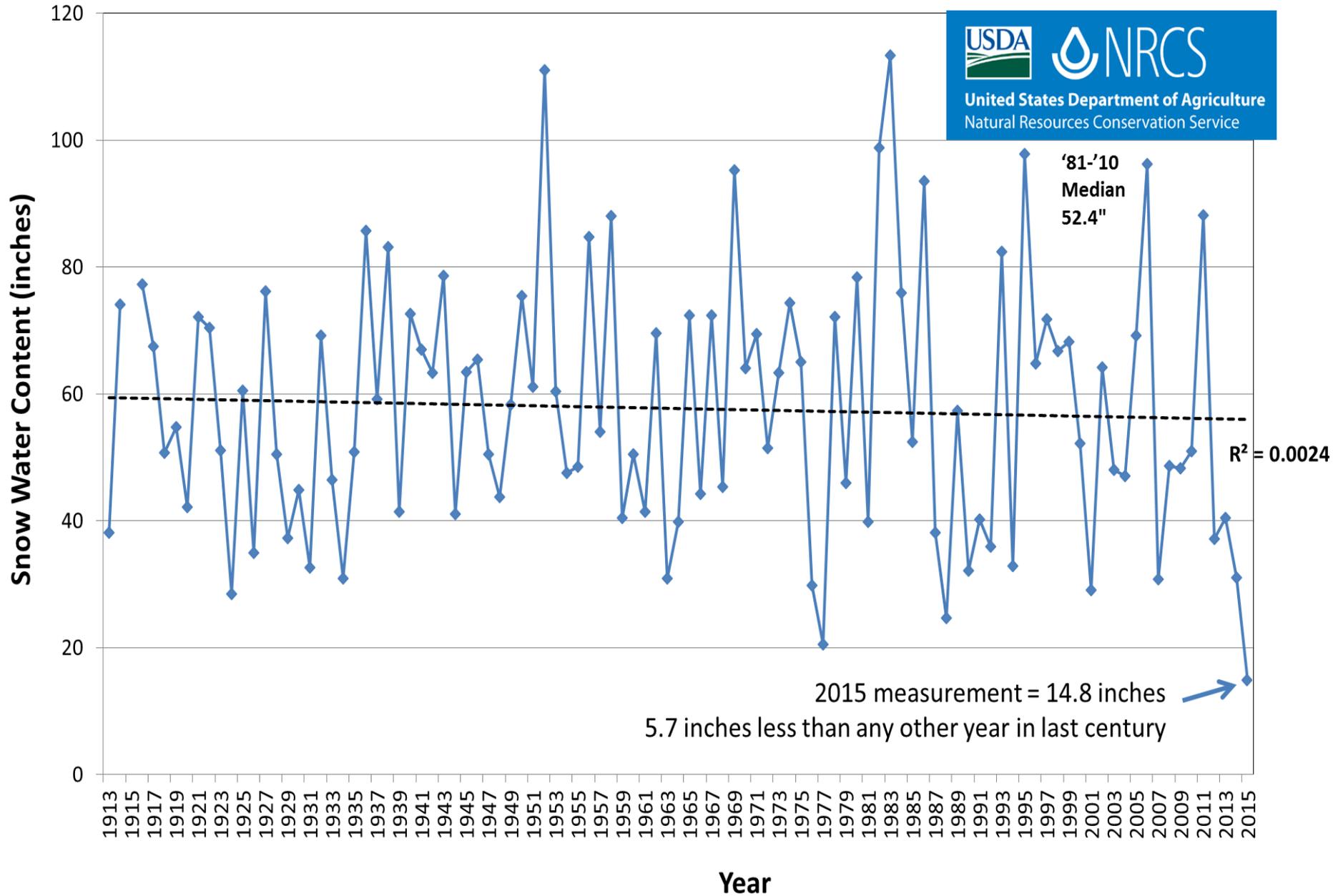
Hagans Meadow SNOTEL, Lake Tahoe Basin, 7,776ft

April 1 Snow Water Content for Years 1916-2015



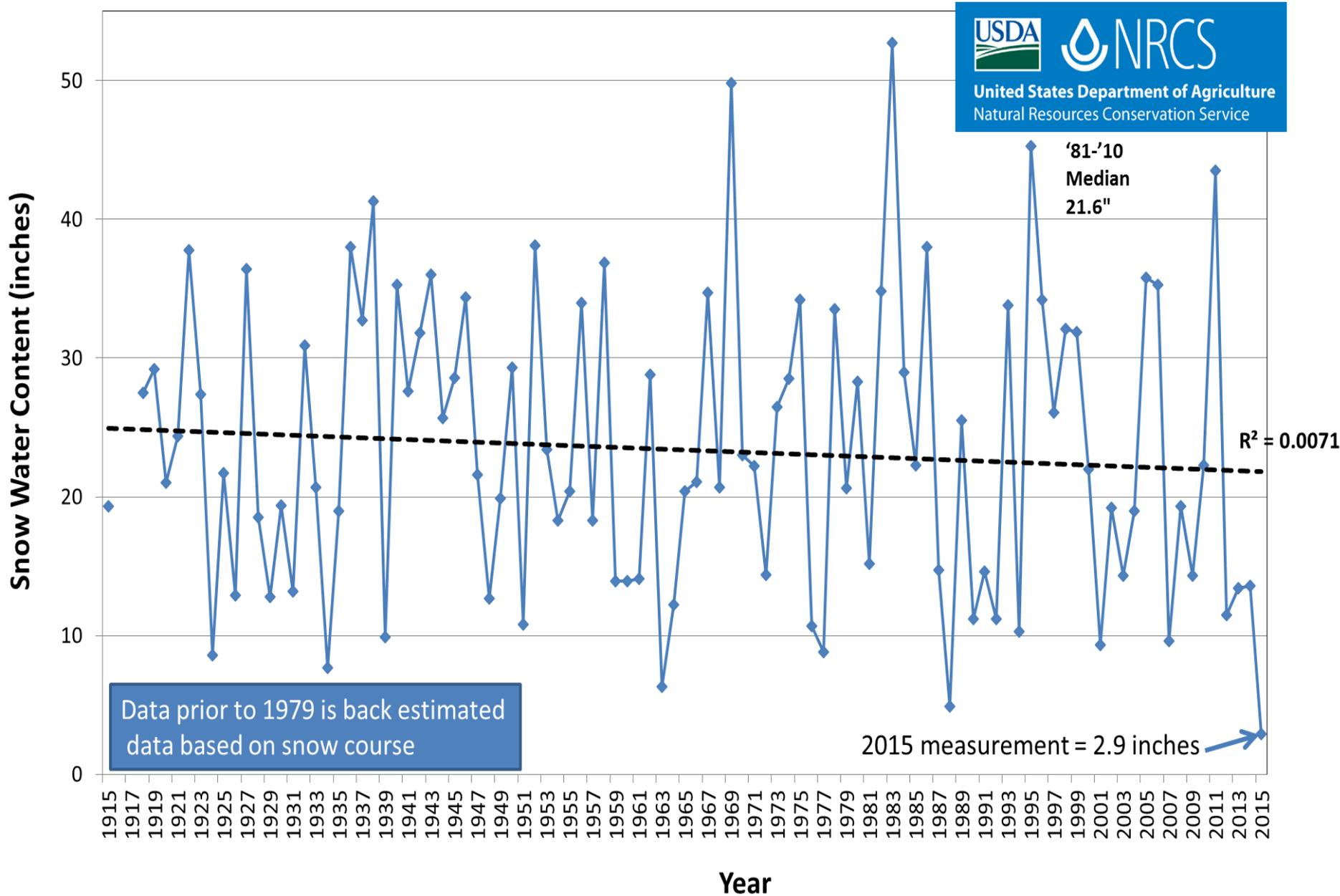
Lake Lucille Snow Course, Lake Tahoe Basin, 8,188ft

April 1 Snow Water Content for Years 1913-2015



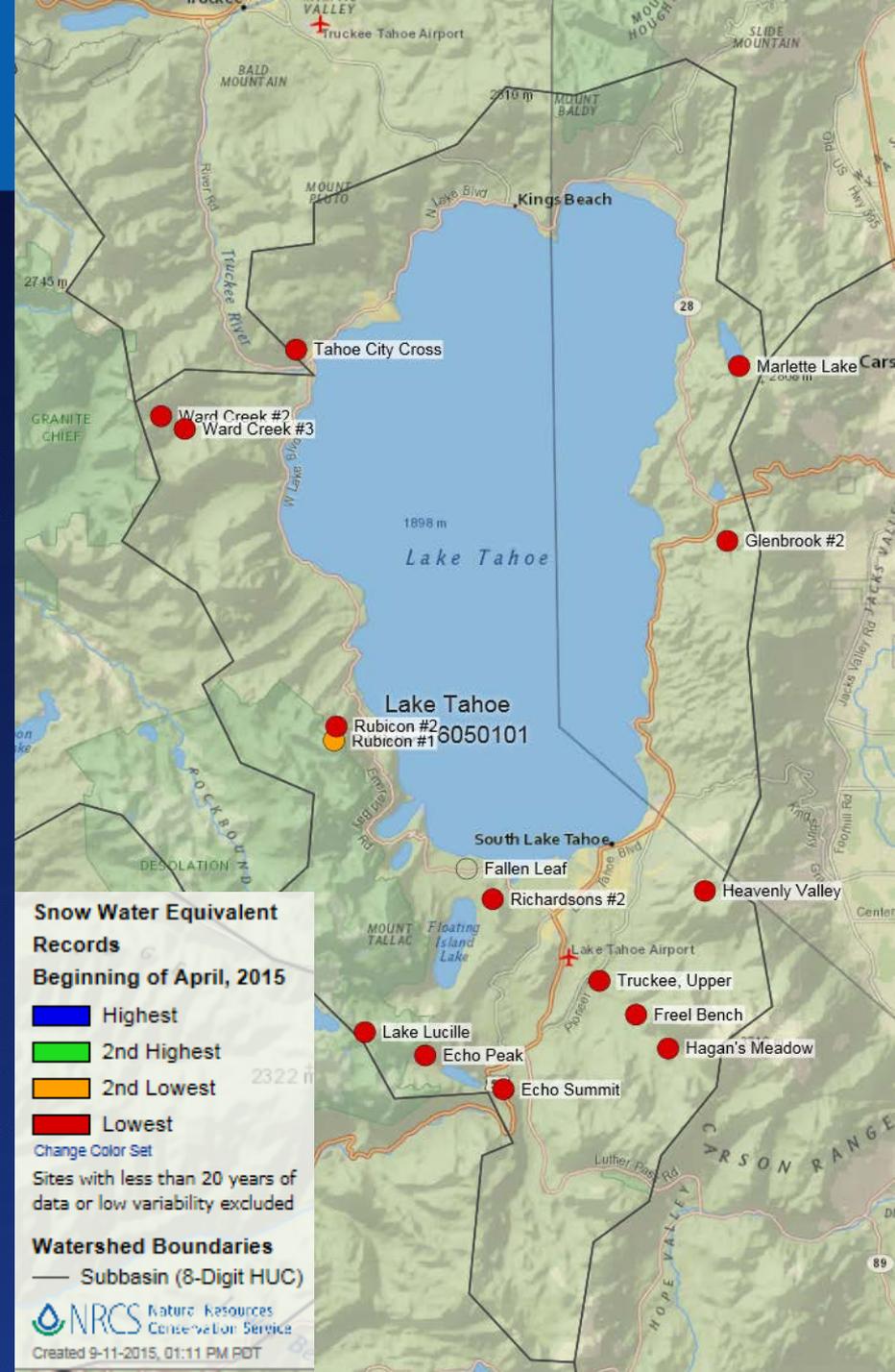
Marlette Lake SNOTEL, Lake Tahoe Basin, 7,880ft

April 1 Snow Water Content for Years 1915-2015



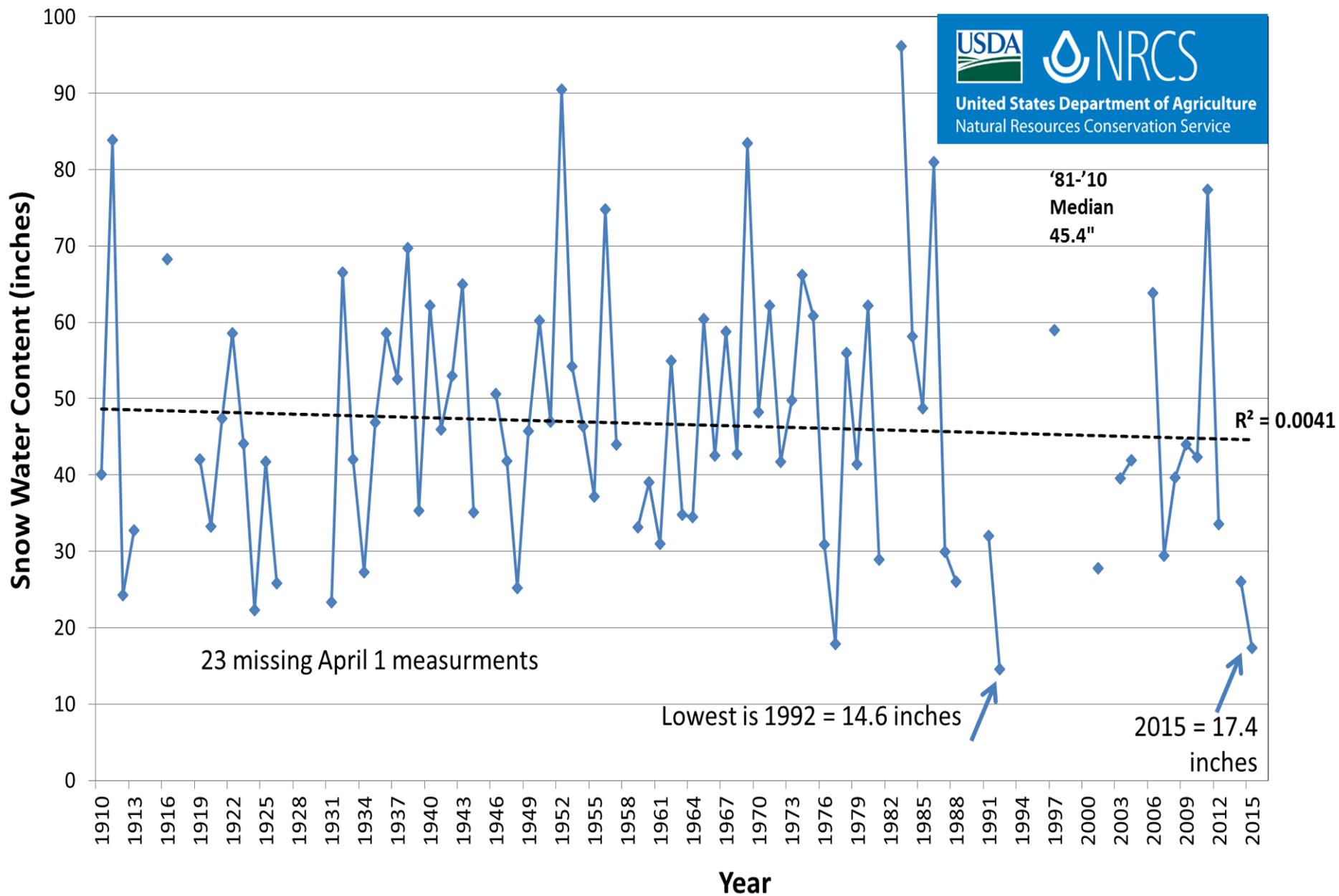
United States Department of Agriculture Natural Resources Conservation Service

15 out of 16 stations set or
tied low SWE records



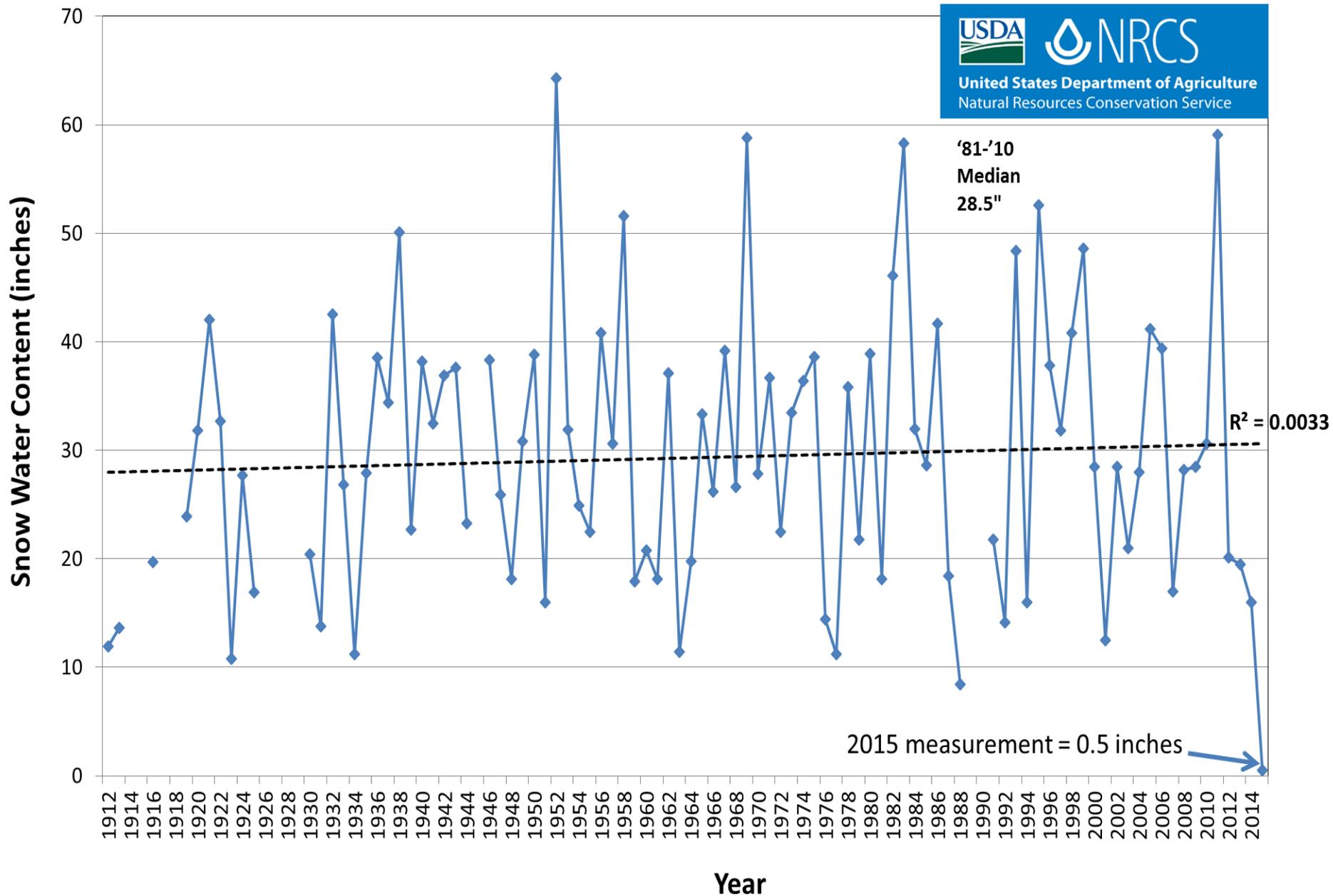
Rubicon #1, Lake Tahoe Basin, 8,100ft

April 1 Snow Water Content for Years 1910-2015

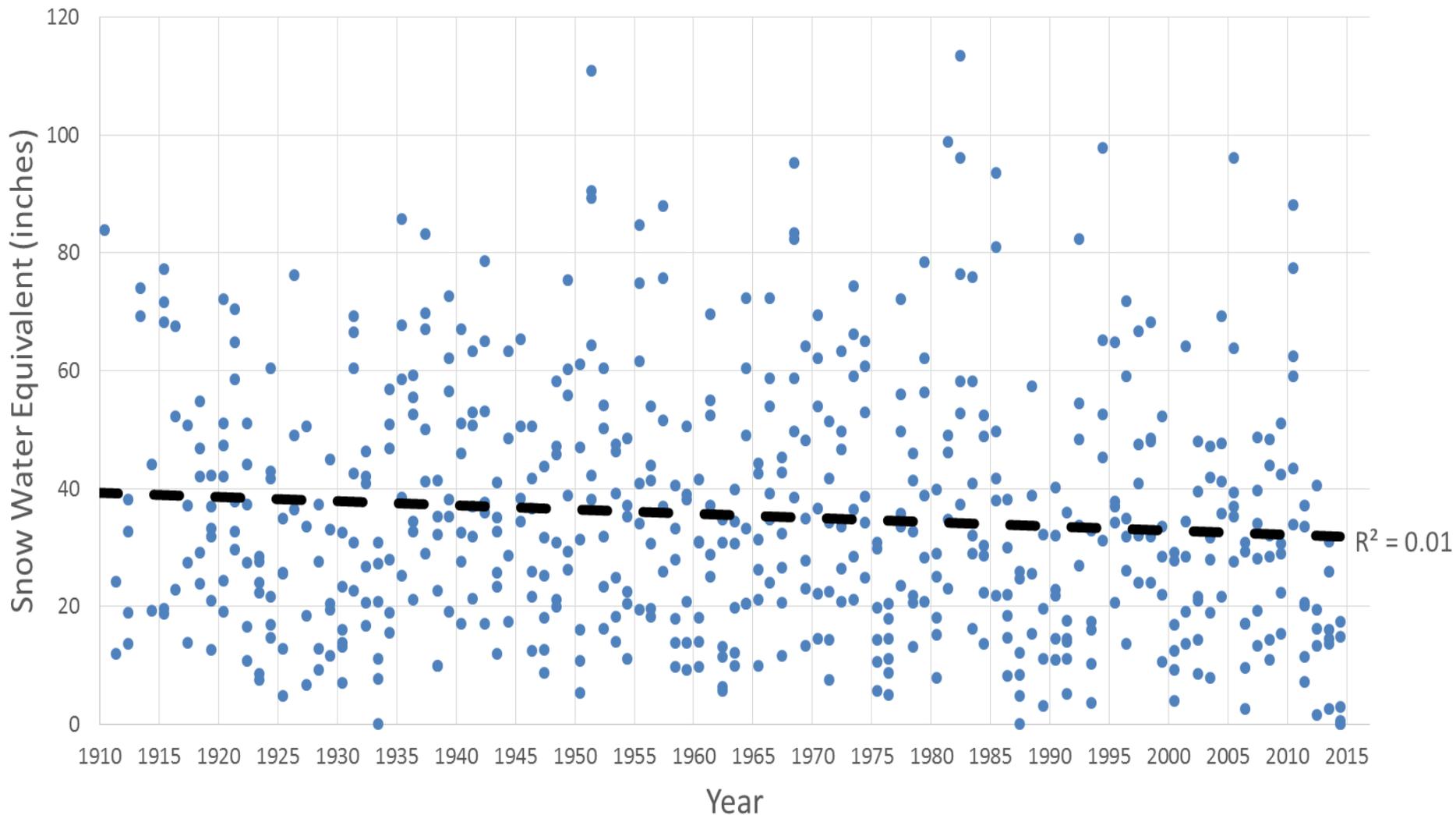


Rubicon #2 Snow Course, Lake Tahoe Basin, 7,560ft

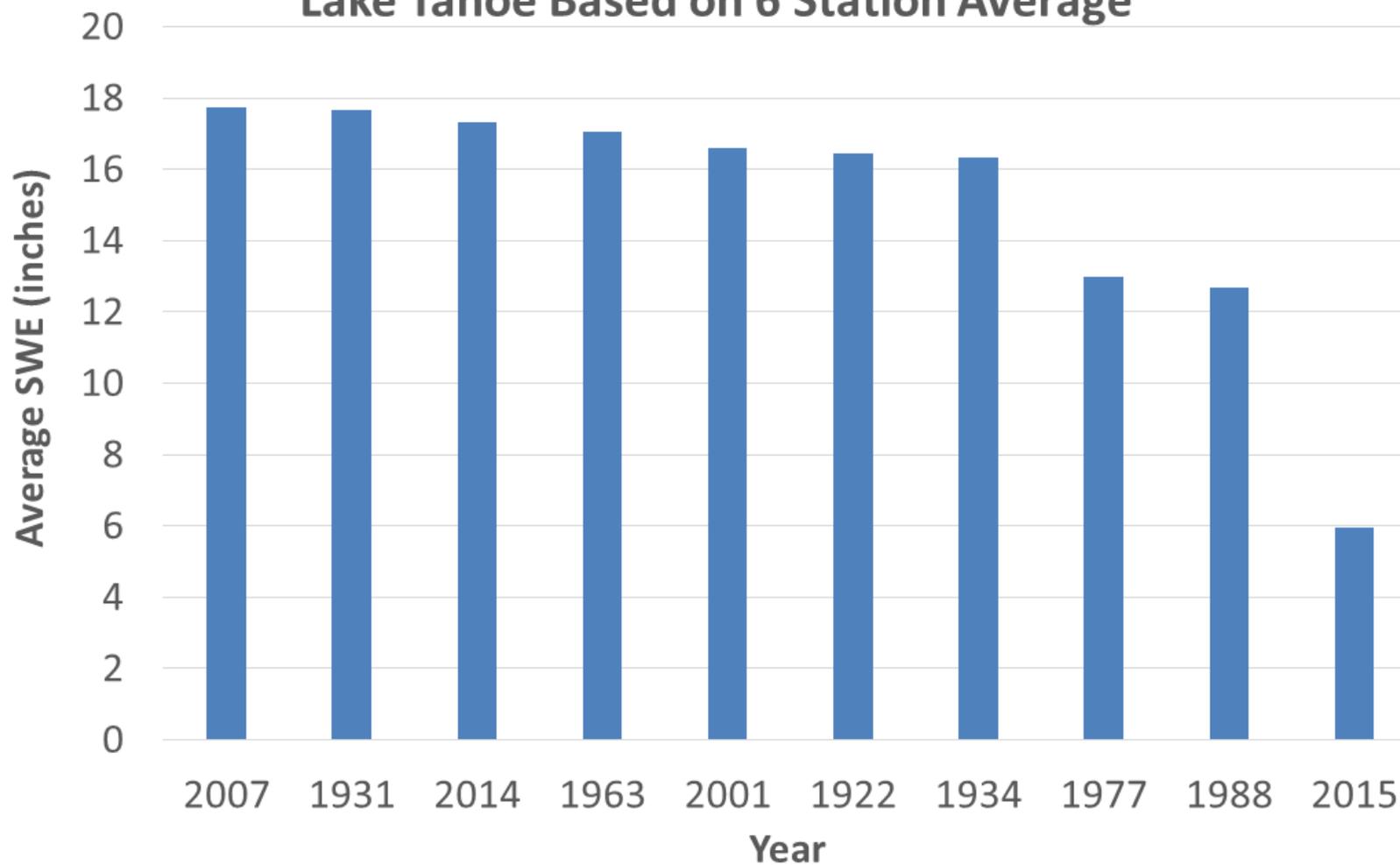
April 1 Snow Water Content for Years 1912-2015

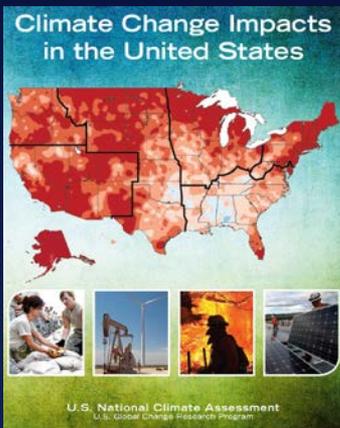


April 1st Snow Course Measurements at the 6 Oldest Snow Courses Lake Tahoe Basin for Years 1910-2015 (n=576)



Comparison of Lowest April 1 Snow Years in Lake Tahoe Based on 6 Station Average

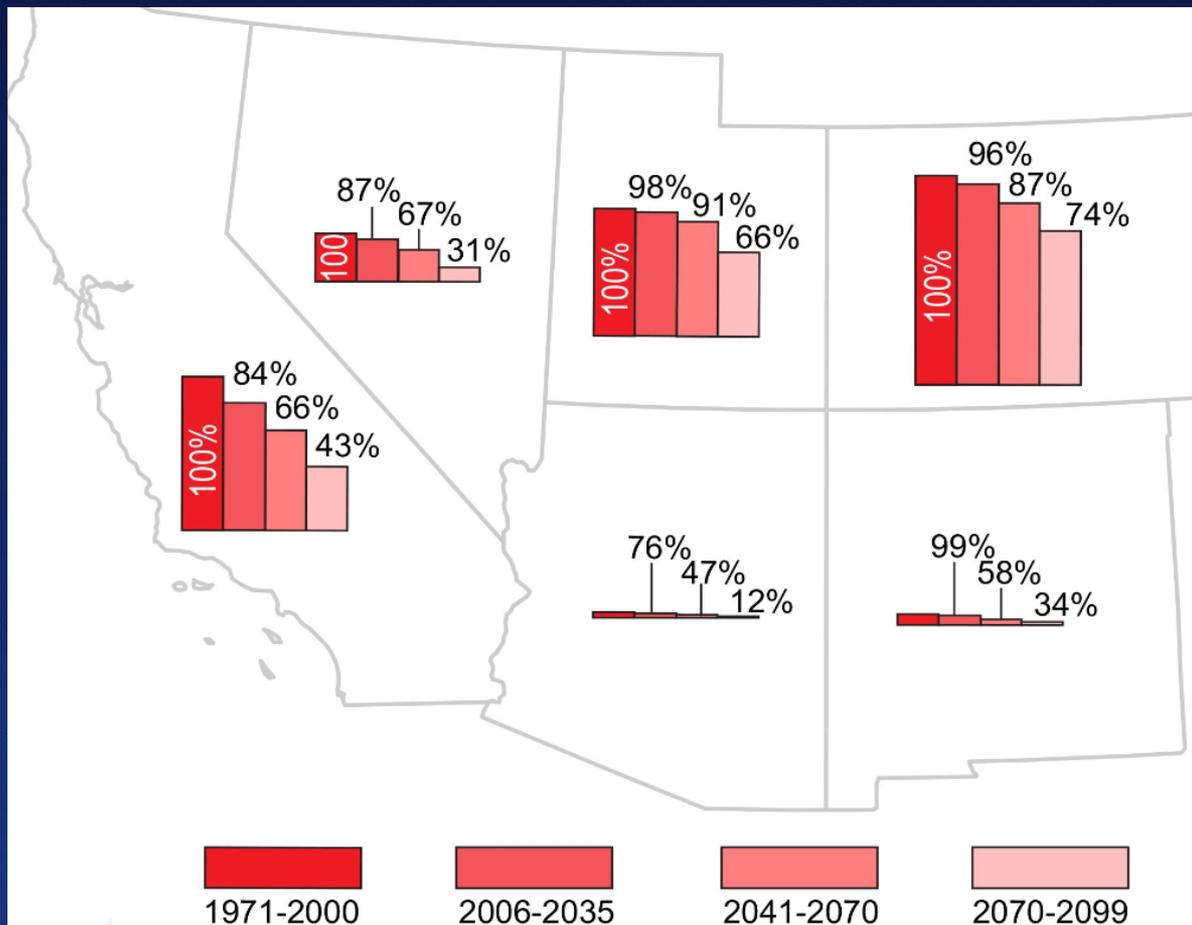




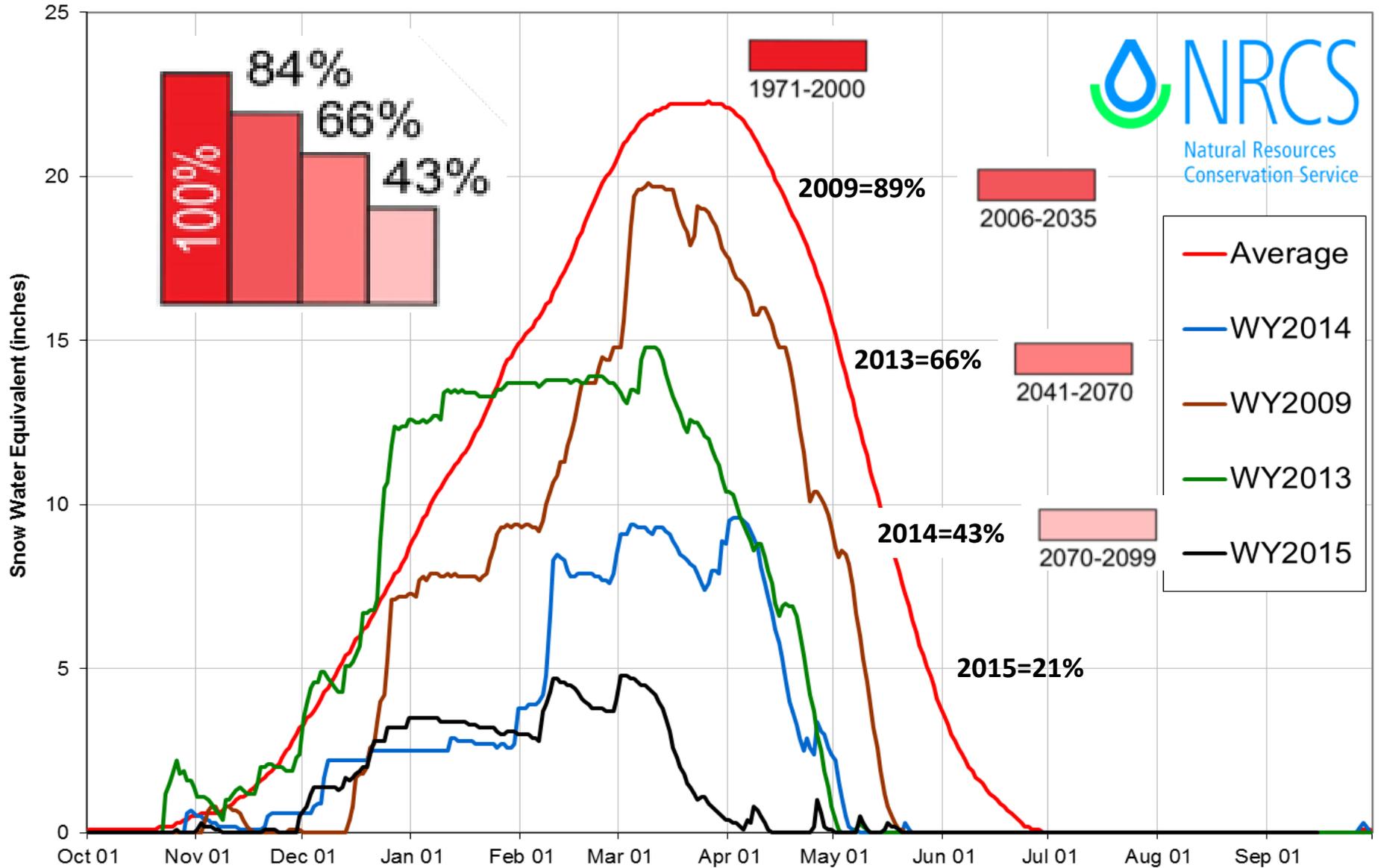
Key Message 1: Reduced Snowpack and Streamflows

Snowpack and streamflow amounts are projected to decline in parts of the Southwest, decreasing surface water supply reliability for cities, agriculture, and ecosystems.

Figure 20.2. Snow water equivalent (SWE) refers to the amount of water held in a volume of snow, which depends on the density of the snow and other factors. Figure shows projected snow water equivalent for the Southwest, as a percentage of 1971-2000, assuming continued increases in global emissions (A2 scenario). The size of bars is in proportion to the amount of snow each state contributes to the regional total; thus, the bars for Arizona are much smaller than those for Colorado, which contributes the most to region-wide snowpack. Declines in peak SWE are strongly correlated with early timing of runoff and decreases in total runoff. For watersheds that depend on snowpack to provide the majority of the annual runoff, such as in the Sierra Nevada and in the Upper Colorado and Upper Rio Grande River Basins, lower SWE generally translates to reduced reservoir water storage. (Data from Scripps Institution of Oceanography).



Lake Tahoe Basin Time Series Snowpack Summary
Based on Provisional SNOTEL data as of Sep 15, 2015



California snowpack lowest in past 500 years

Tree rings help to put the state's historic drought in context.

Chris Cesare

14 September 2015

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Max Whittaker/Getty Images

A historic drop in spring snowpack has affected recreation in the Sierra Nevada mountains.

The spring snowpack on mountains crucial to California's water supply reached its lowest level this year in half a millennium, according to a study published¹ on 14 September in *Nature Climate Change*.

Figure 1: Sierra Nevada 1 April snow water equivalent reconstruction (1500–1980).

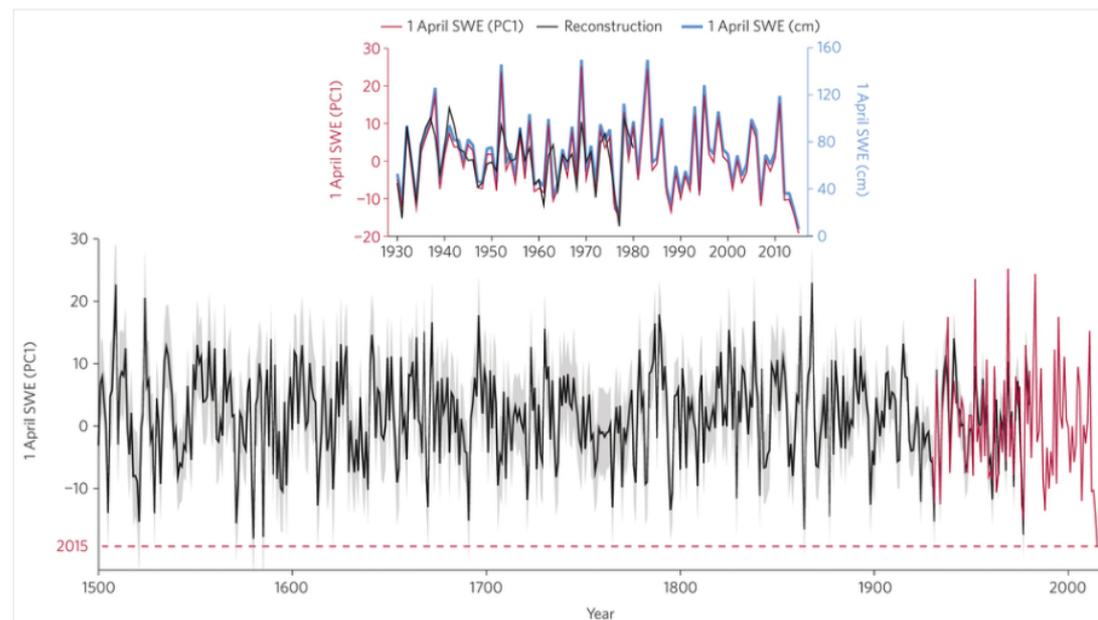
From

Multi-century evaluation of Sierra Nevada snowpack

Soumaya Belmecheri, Flurin Babst, Eugene R. Wahl, David W. Stahle & Valerie Trouet

Nature Climate Change (2015) | doi:10.1038/nclimate2809

Published online 14 September 2015



Bottom: instrumental (1930–2015; red curve) and reconstructed (1500–1980; black curve) first Principal Component (PC1) of Sierra Nevada 1 April snow water equivalent (SWE) values. The SWE reconstruction was calibrated against the PC1 of 1 April SWE measurements from 108 Sierra Nevada stations and explains 63% of its variance over the period of overlap (1930–1980; top). The 108-station average SWE value (in cm; 1930–2015) is plotted for comparison (blue curve; top). The grey shading around the reconstruction (bottom) indicates the combined error estimation (Supplementary Information). The 2015 SWE value is indicated by the red dashed line.

Summary:

- The Lake Tahoe Basin has the longest SWE data set in the U.S.
- Six stations have data sets that start between 1910-1916.
- April 1, 2015 set a new low for seasonal snow water accumulation.
- April 1 snow data shows high degree of annual variation, but overall trend is downward over last century.

USDA United States Department of Agriculture

Natural Resources Conservation Service

Nevada Water Supply Outlook Report March 1, 2015

Photo - Jim Gifford

Finally, some snow at lake level.
Crystal Bay, Nevada along the north shore of Lake Tahoe on March 3, 2015

Snow down to the shore of Lake Tahoe has been a rare sight this winter. With the exception of a little snow on the ground between Christmas and New Year's the lake shore was bare until the very end of February. The Lake Tahoe Basin snowpack is currently 23% of normal based on measurements made for the March 1 survey. Tahoe's snowpack has been at or near record low amounts since late January based on daily SNOTEL data. The last time we had a snowpack similar to this year was 1991. Record low snow conditions exist all around Nevada, see page 5 for details.

USDA Natural Resources Conservation Service
Nevada
United States Department of Agriculture

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Snow Survey

Nevada Snow Survey Program

The NRCS Snow Survey Program provides mountain snowpack data and streamflow forecasts for the western United States. Applications of snow survey products include water supply management, flood control, climate modeling, recreation, and conservation planning.

Latest Snow and Water Supply Information:

- Weekly Drought Monitor Conditions: Nevada | Westwide
- Weekly Westwide NRCS Water and Climate Update
- Weekly El Niño Status Update (courtesy of NOAA)
- Today's Nevada Snow and Precipitation Update Reports: Snow and Precipitation - Bureau of Normal

Snow Survey Data

- Interactive Map: (zoom, click site for data)
- SNOTEL | Snow Course | SCAN
- Site Pages: Select a SNOTEL site
- Current and Historic Data Reports
- 30 Year Normals
- Metadata: Location | Site Photos

SNOTEL Products

- Snow & Precipitation Update Reports
- Monthly Basin Reports (select snow or prec)
- Snowpack Graphs: SNOTEL | Basin
- Daily Map Products: Snow | Prec | Temp
- Interactive Map Conditions Links - NEW!

Water Supply Information

- Outlook Reports: March 2015
- Streamflow Forecasts: Select date
- Streamflow Forecast Maps: NV | West US
- Daily Streamflow Forecasts - NEW!
- Monthly Reservoir Report (select reservoir)
- USGS Conditions: Stream | Reservoir
- Water Supply Presentations

Climate and Drought Information

- NRCS Weekly Water & Climate Report
- Climate Links: (PREISM, AGACIS, Wind data)
- Nevada Climate Summaries (by county)
- Great Basin Weather & Climate Dashboard
- US Drought Monitor

Data Query Tools

- Report Generator: Custom Search | Help
- Web Service

Other Snow Survey Programs:

- National Water and Climate Center
- Other NRCS States
- California Dept of Water Resources

Contact Nevada Snow Survey

2015 NRCS Nevada-California Snow Measurement Schedule

Click here for the old Nevada Snow homepage

www.nv.nrcs.usda.gov/snow

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