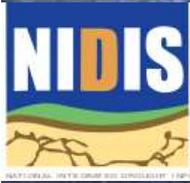


Snow Drought: Concepts, Monitoring, and Impacts



**Dan McEvoy, Regional Climatologist
Western Regional Climate Center
Desert Research Institute**

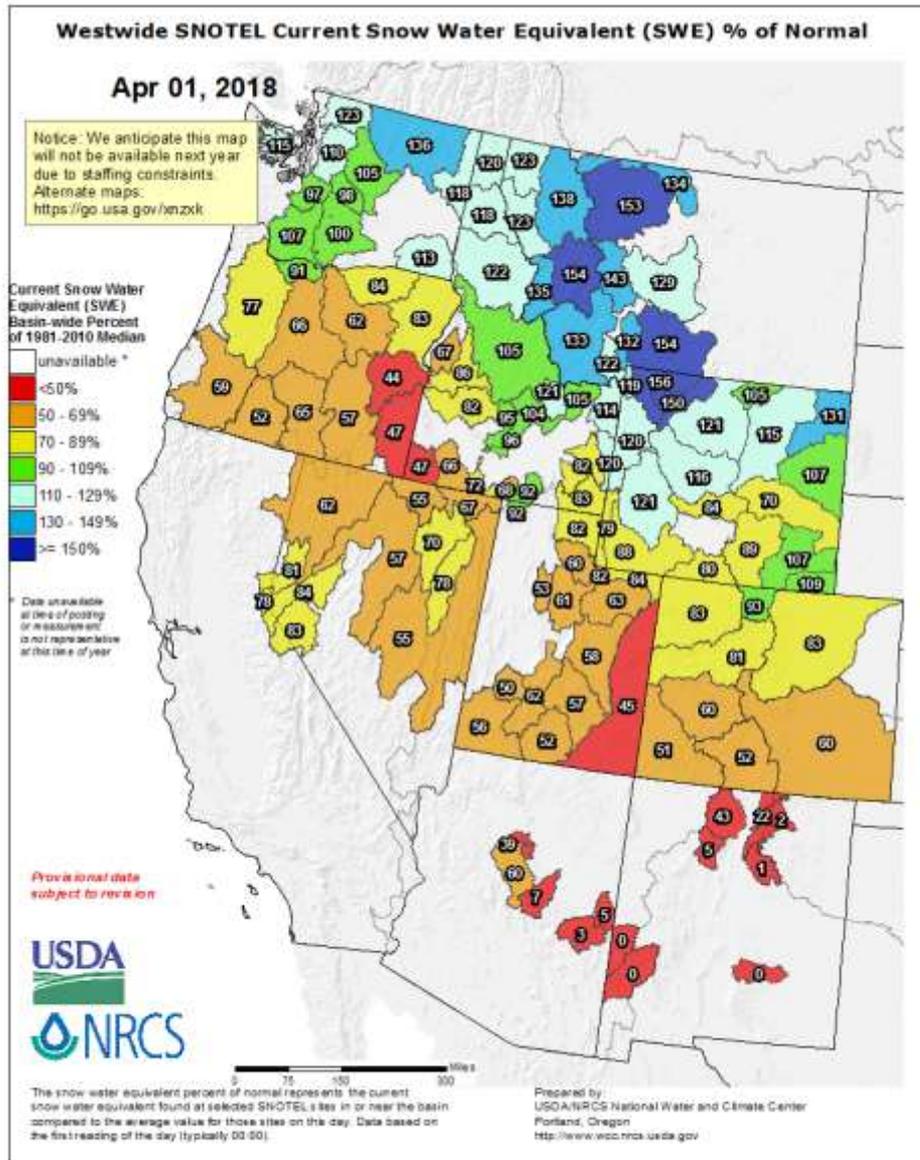
**Ben Hatchett
Desert Research Institute
Western Regional Climate Center**

A green rectangular sign with white text that reads 'ELEVATION 8000 FT'. The sign is mounted on a wooden post. The background shows a rugged mountain range with some snow patches under a clear blue sky. The foreground is a dry, rocky slope with sparse, brownish vegetation.

**ELEVATION
8000 FT**

Tioga Pass, CA, January 12, 2015
Photo Credit: Bartshe Miller

Snowpack alone may not tell the whole story



- How did we get to the April 1 snow water equivalent (SWE) values?
- Were these values purely driven by precipitation deficits (or surplus)?
- What role is temperature playing?
- What are the impacts?

Defining Snow Drought and Why It Matters

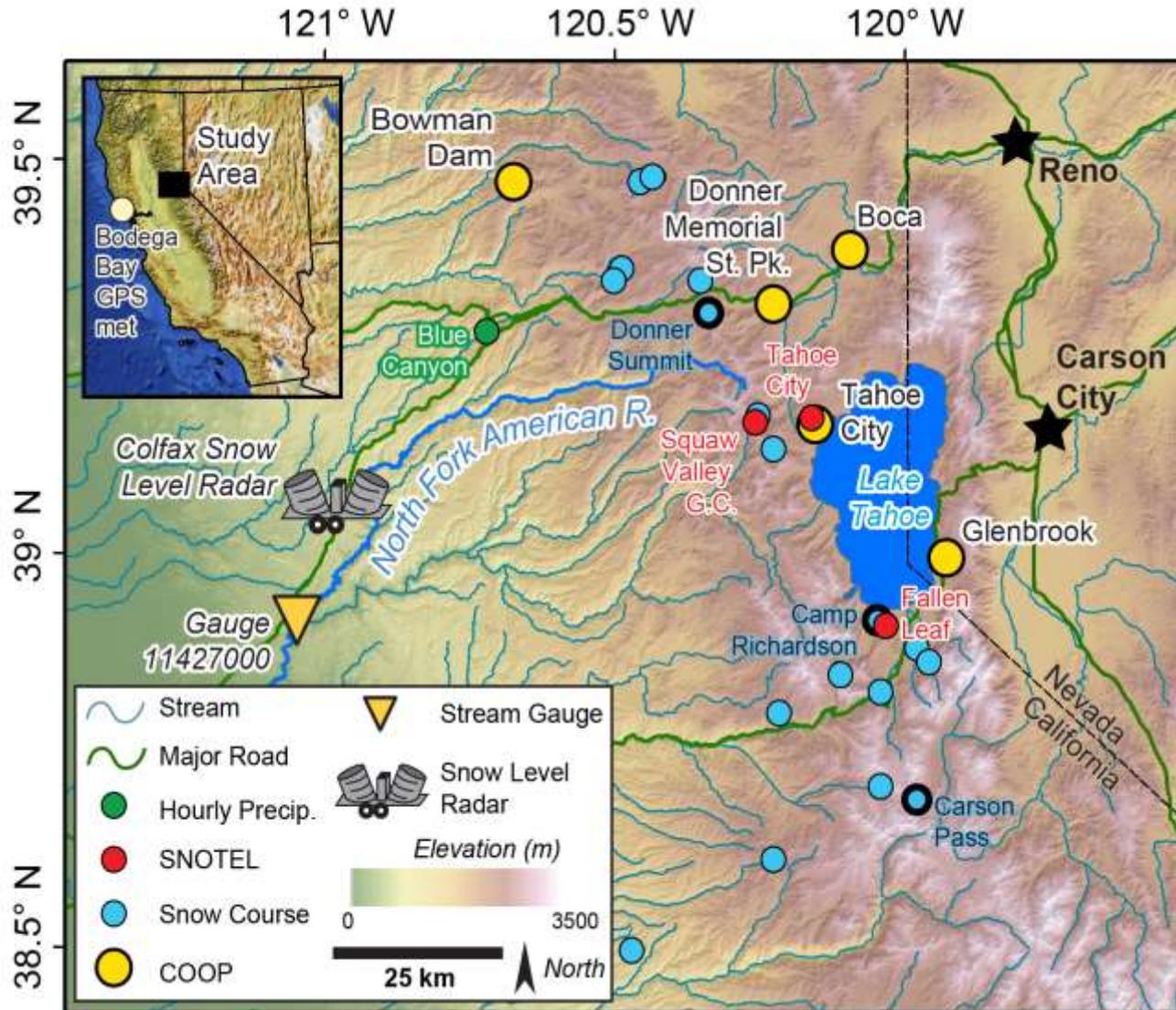
Swings from snow drought to extreme winter rainfall make managing reservoirs, like the Oroville Dam, incredibly difficult. But what exactly is "snow drought"?



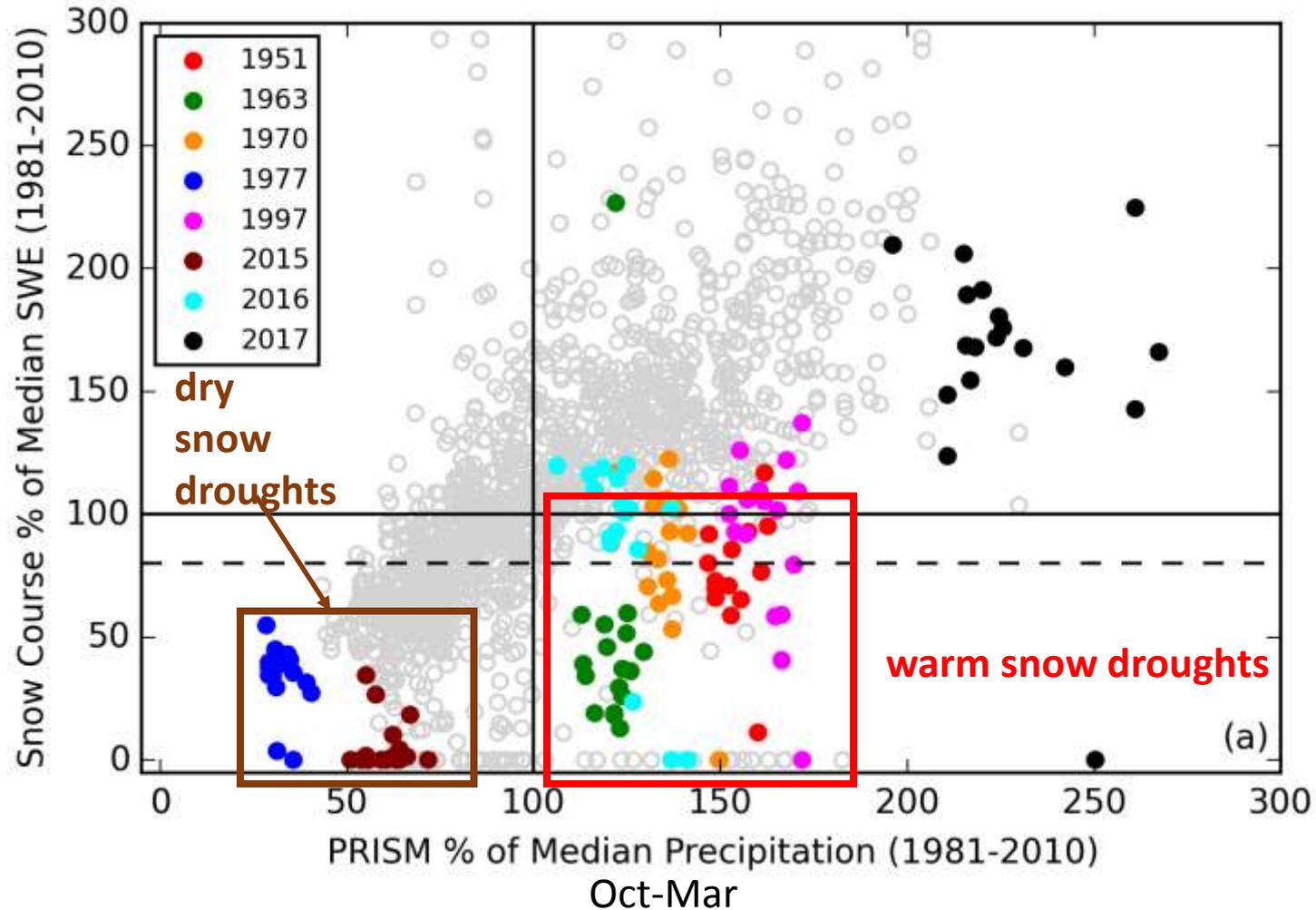
Two types of snow drought:

- 1. Dry**, driven by precipitation deficits
 - Precipitation and snow water equivalent (SWE) below average
 - 2. Warm**, driven by above average temperatures
 - Precipitation above average and SWE below average
- Both types result in below average SWE
 - Snow drought year commonly defined by April 1 SWE value

Northern Sierra Nevada Snow Droughts

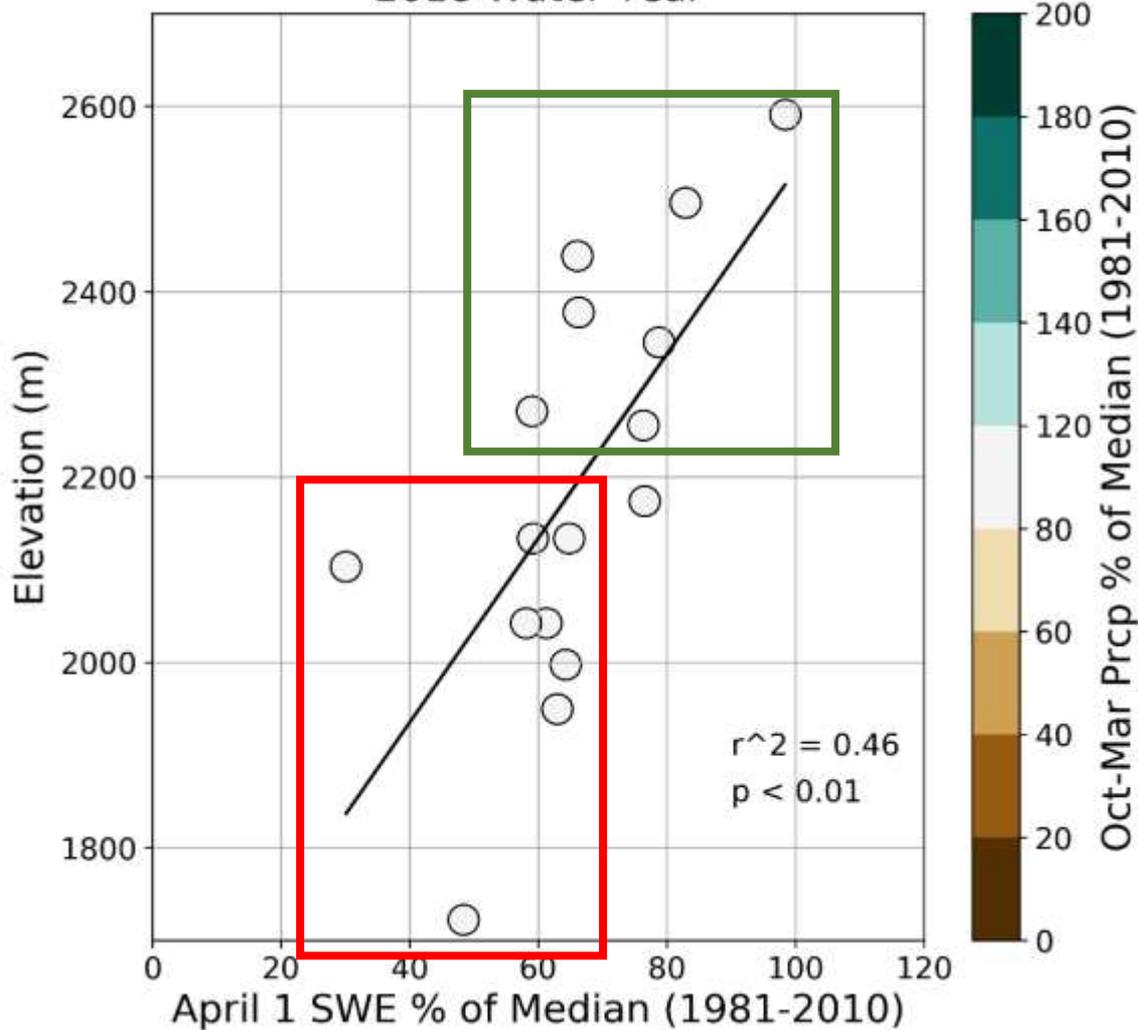


Northern Sierra Nevada April 1 Snow Droughts



Elevational SWE Gradients in Warm Snow Droughts

Lake Tahoe Region Snow Courses
2018 Water Year



- 2018...another warm snow drought year (more on this later)
- 50-70% of median SWE at lower elevations
- 60-100% of median SWE at higher locations

Monitoring: Drought.gov

Current conditions, updated bi-weekly

The screenshot shows the Drought.gov website with the 'Snow Drought' section highlighted. The page includes a navigation bar with links like Home, Data, Maps & Tools, Reports, Research, Resources, What is DROUGHT, News, Calendar, and Contact Us. Below the navigation bar, there are links for Current Conditions, National Forecasts, Impacts, Soil Moisture, Irrigation, Fire, Temperature & Precipitation, Agriculture, Water Supply, and Resilience. The main content area is titled 'Snow Drought' and contains a 'What is Snow Drought?' section, a 'Current situation and impacts in the West' section with a date of April 11, 2018, and a map of the western United States. There is also a 'Report an Impact!' section and a 'Key Partners' section with logos for NIDIS and the U.S. Drought Portal.

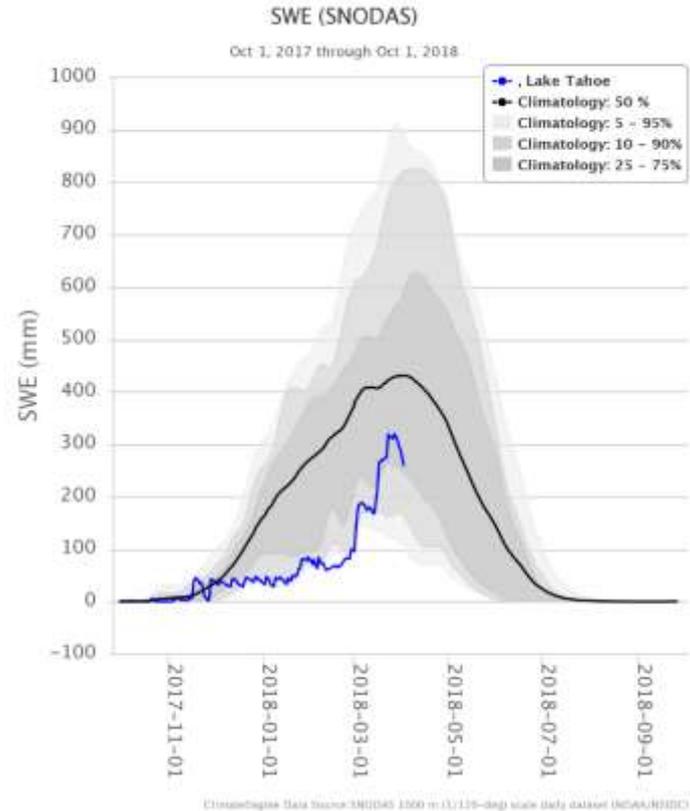
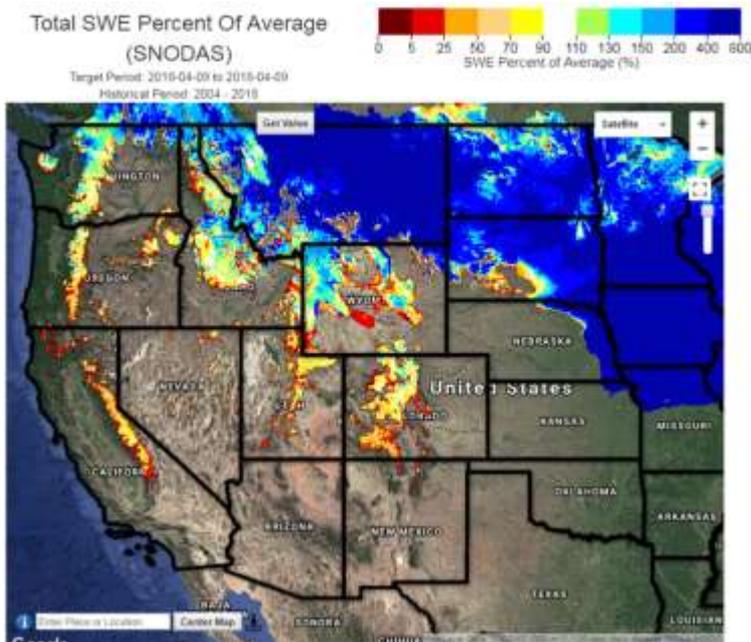
Snow Drought Tools Dashboard

The screenshot shows the 'Snow Drought Tools' dashboard. It features a grid of tool cards. The first card is 'NRCS SNOTEL & Snow Course Data', which includes a map of the western U.S. and text describing point maps and interactive maps of snow water equivalent, snow depth, and snow density. The second card is 'Climate Engine SNODAS SWE', which includes a map of the western U.S. and text describing on-demand processing of satellite and climate data. The third card is 'NOHRSC National Snow Analysis', which includes a map of the western U.S. and text describing gridded snow data. The fourth card is 'CA-NV River Forecast Center (CNRFC)', which includes a map of the western U.S. and text describing observations and forecasts. The fifth card is 'Colorado Basin River Forecast Center (CBRFC)', which includes a map of the western U.S. The sixth card is 'Northwest River Forecast Center (NWRFC)', which includes a map of the western U.S.

Big thanks to all the NIDIS regional coordinators and staff for making this happen!

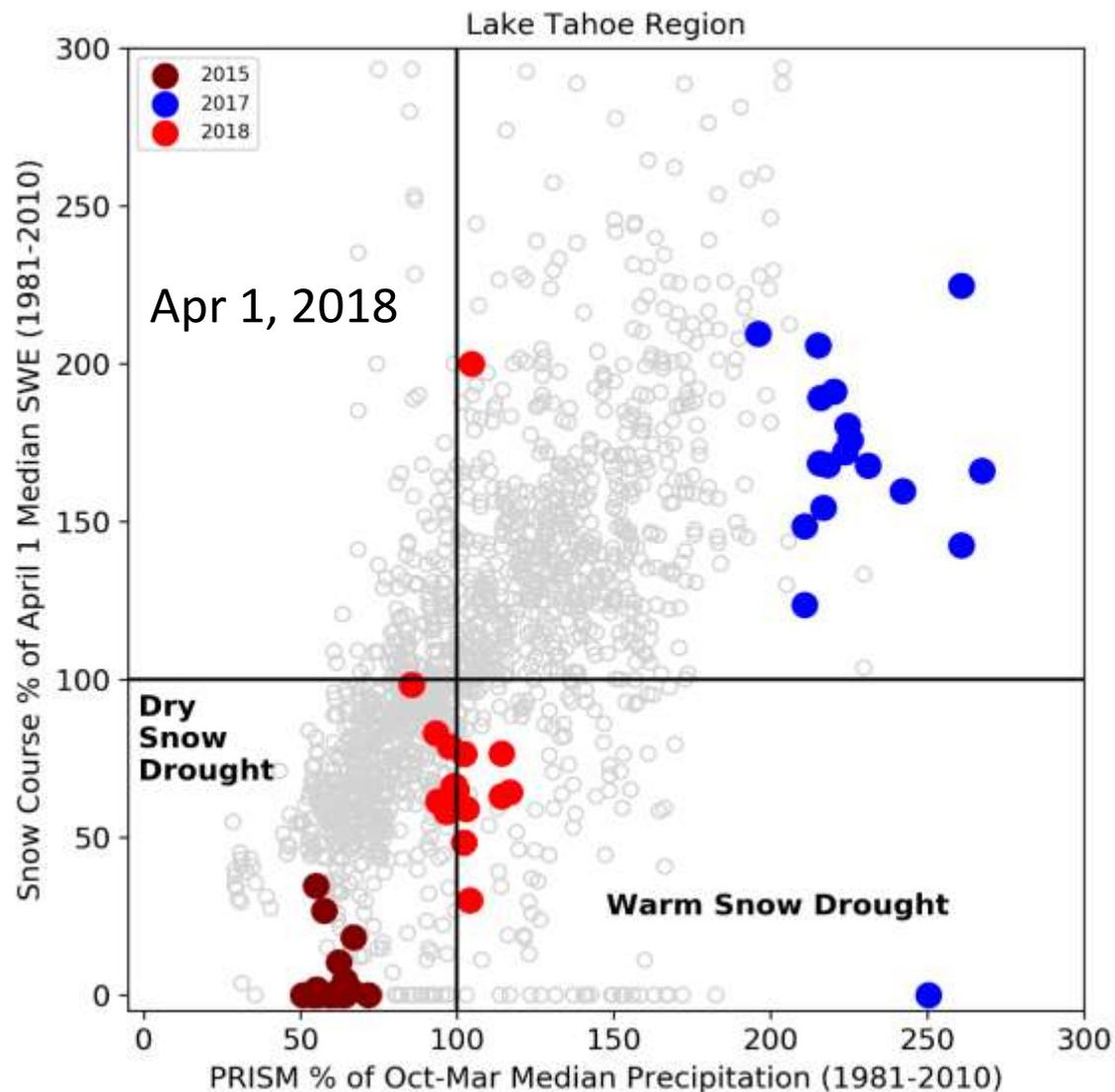
<https://www.drought.gov/drought/data-maps-tools/snow-drought>

Monitoring: Climate Engine



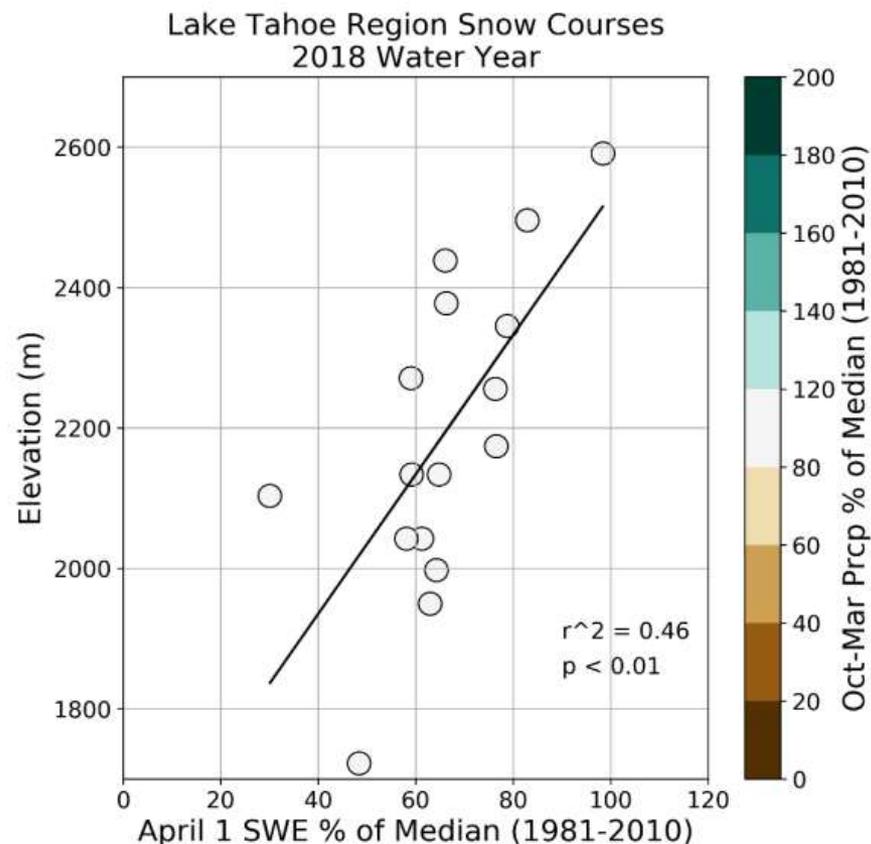
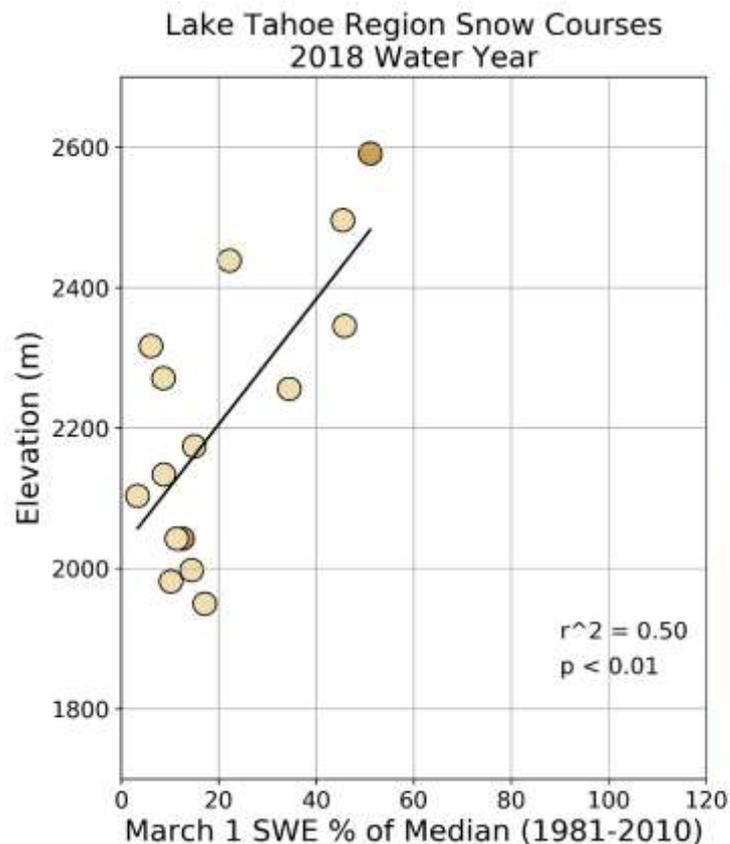
- SNOW Data Assimilation System (SNODAS) made available on Climate Engine in early 2018
- SWE and snow depth, anomaly maps, time series
- Short period of record (2003-present)

Monitoring: Products in development



- Regional SWE vs. precipitation scatters
- Snow Course SWE
- PRISM precipitation
- Can easily be applied to other regions
- Move from manual updates to automated processing

Monitoring: Products in development



- Regional SWE vs. elevation scatters
- Classify warm and dry snow drought at each location

Monitoring: Social Media



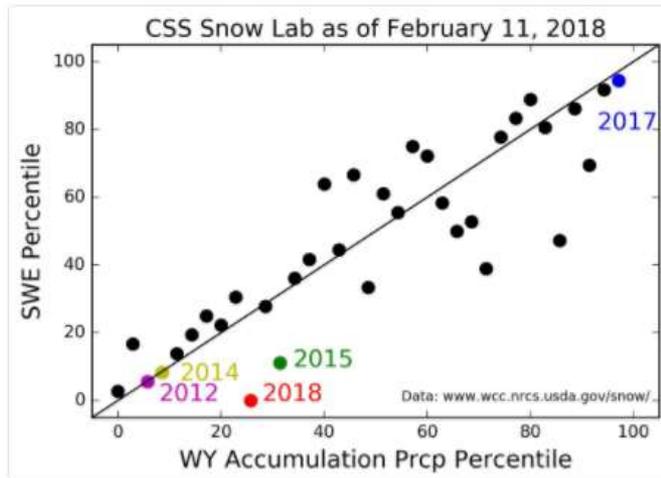
Dan McEvoy
@hydromet_man



Update on Donner Summit snow drought:
2018 now the lowest SWE in SNOTEL record
for Feb 11.

Current SWE percentile: 0
Current P percentile: 26th

Deep dry type [#snowdrought](#) now in place.
Quickly falling below 2015 for both SWE and
P.



9:12 AM - 11 Feb 2018

44 Retweets 43 Likes



Desert Research Institute, WRCC, CNAP_RISA and 2 others

4 44 43

- 20,479 impressions on Twitter
- Weather, climate, hydrology community very interested in this topic
- General public, especially those who live in mountain towns, are also very interested

https://twitter.com/hydromet_man/status/962736040099291136

Recreational Impacts

LA Times, February 13, 2018

Dry, hot California winter closes ski resorts, stalls wildflower blooms and revives drought fears

Royal Gorge, Tahoe Donner, TahoeXC and other Nordic trails were closed to skiers, in hibernation until the next storm. Fat tire biking instead was in order.



Teton Gravity Research, April 3, 2018

HISTORICALLY LOW SNOWFALL CLOSSES SAN JUAN SKI RESORTS

Apr 03, 2018 | By: [Katie Lozancich](#) | [Follow](#) | 0 | 0

Yosemite Ski and Snowboard Resort, February 21, 2018

Season Pass Update 2/21/2018: Thank you, everyone, for your patience. Unfortunately, there is not enough snow right now or in the near forecast to open, so the Yosemite Ski & Snowboard Area will not open for the 2017-18 season. We are contacting all season pass holders via email to offer the option of a season pass roll over to the 2018-19 season or a refund. Thank you for your continued interest in California's original ski area, and we hope to see you next year!

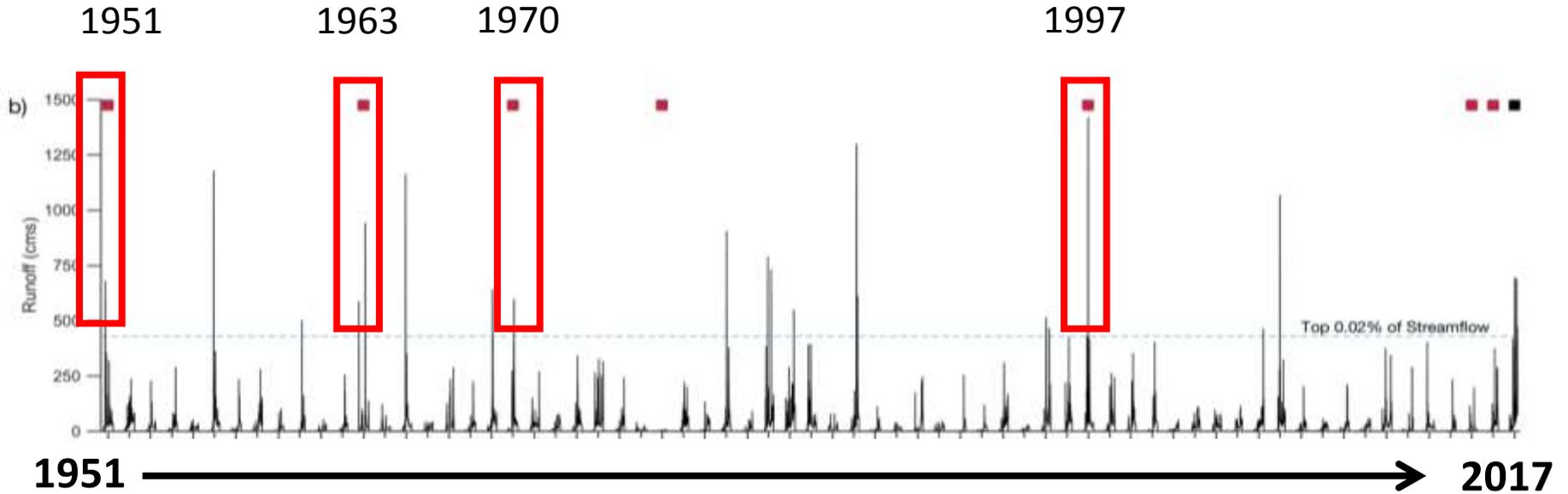
Recreational Impacts



Photos: Dan McEvoy

- Not ALWAYS bad!
- Mountain biking in early January near 7,000 feet in the Sierra Nevada foothills

Hydrologic Impacts



Daily Oct-Mar Streamflow at North Fork American River, 1951-2017

- Four of seven snow drought year coincided with peak runoff
- You CAN have floods during drought years

Summary

- Two primary snow drought types: warm and dry
- April 1 SWE and Oct-Mar precipitation can be used identify snow droughts ***at a single point in time***
- Snow droughts have major recreational and hydrologic impacts
- More research needed to better understand hydrological and ecological impacts of snow drought
- Impacts on fire season?
- Develop a real-time snow drought monitor?
- How is/should snow drought and the impacts be incorporated in the Drought Monitor products?

Thank you!

Questions?

✓ mcevoyd@dri.edu

Lake Tahoe as seen from
top of Incline Peak, NV.
February, 2014

