December 28, 2017, Lake Tahoe CA/NV

Development of Real Time Snow Drought Tracking Tools for the Western United States

Dan McEvoy, Ben Hatchett, and Justin Chambers, Desert Research Institute/Western Regional Climate Center

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NIDIS
NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

Western Regional Climate Center

DRI
Desert Research Institute

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"?

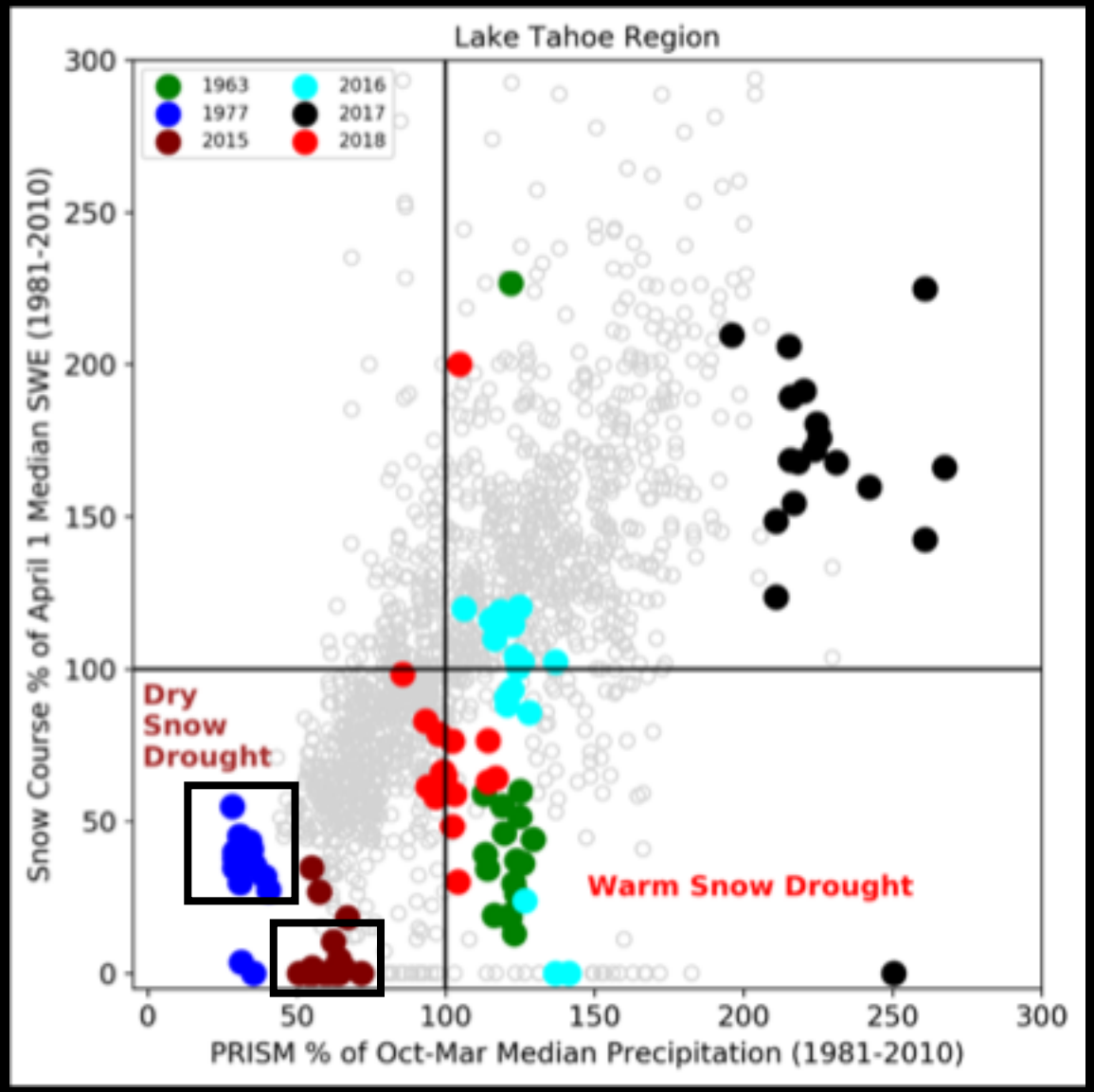
1. **Dry**, driven by precipitation deficits
   - Precipitation and snow water equivalent (SWE) below average

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
- Lots of ambiguity in these definitions

Harpold, A. A., M. Dettinger, and S. Rajagopal (2017), Defining snow drought and why it matters, *Eos,* **98**, https://doi.org/10.1029/2017EO068775

Northern Sierra Nevada April 1 Snow Droughts



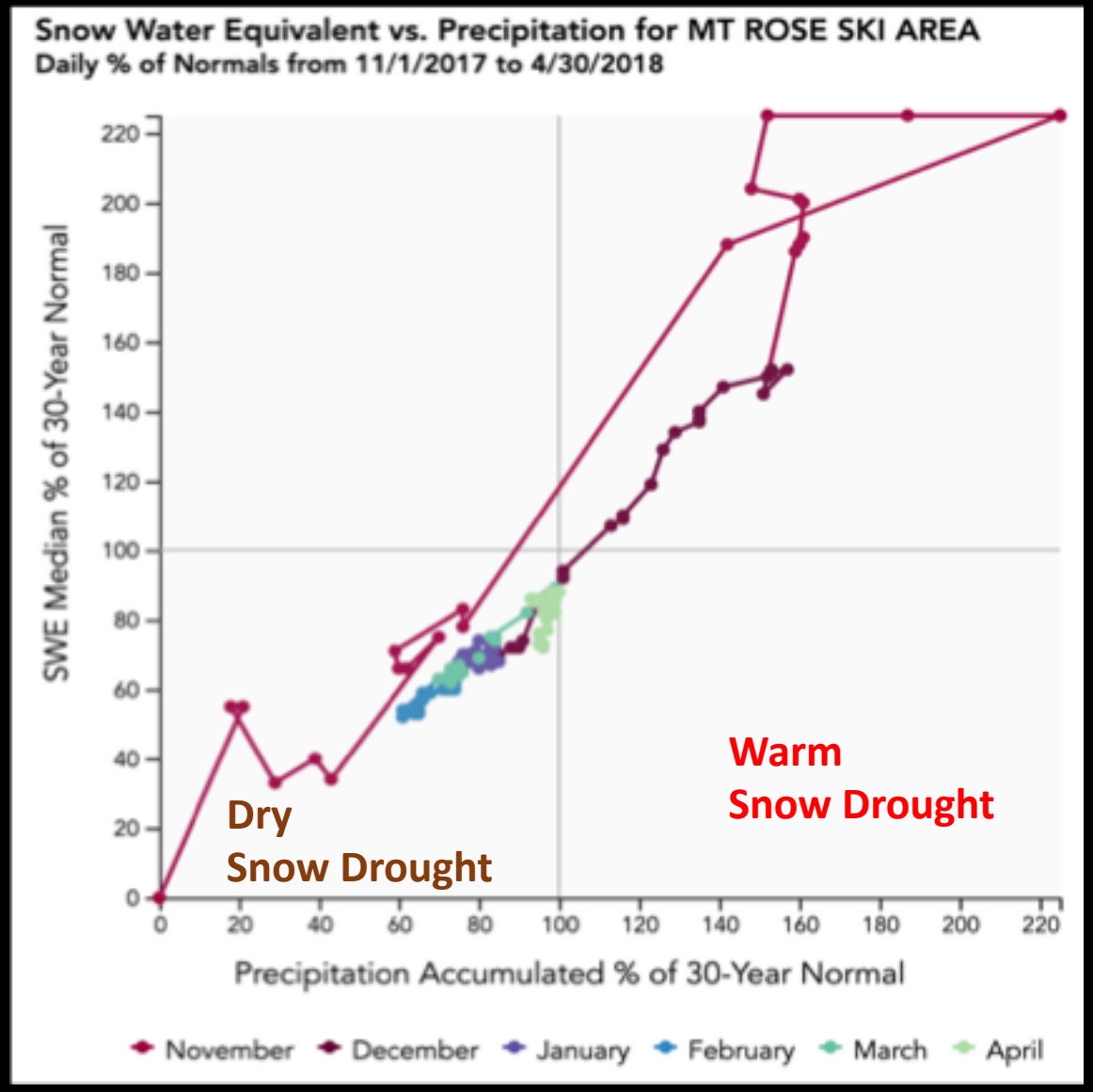
- Each dot represents an April 1 SWE measurement from 16 different manual snow courses around the Northern Sierra Nevada, 1950-2018

- Dry snow drought = meteorological drought

- Some years are a blend of dry + warm snow drought

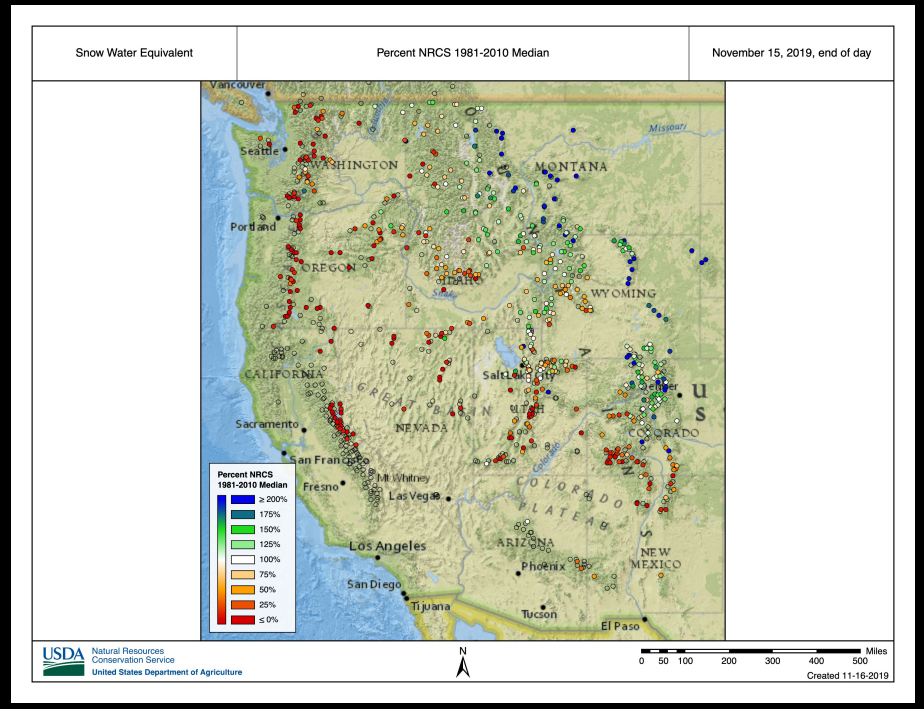
Modified from: Hatchett, B. and D. J. McEvoy (2018), Exploring the origins of snow drought in the northern Sierra Nevada, California, *Earth Interactions*, **22 (2)** https://doi.org/10.1175/EI-D-17-0027.1.

Temporal Variability of Snow Droughts



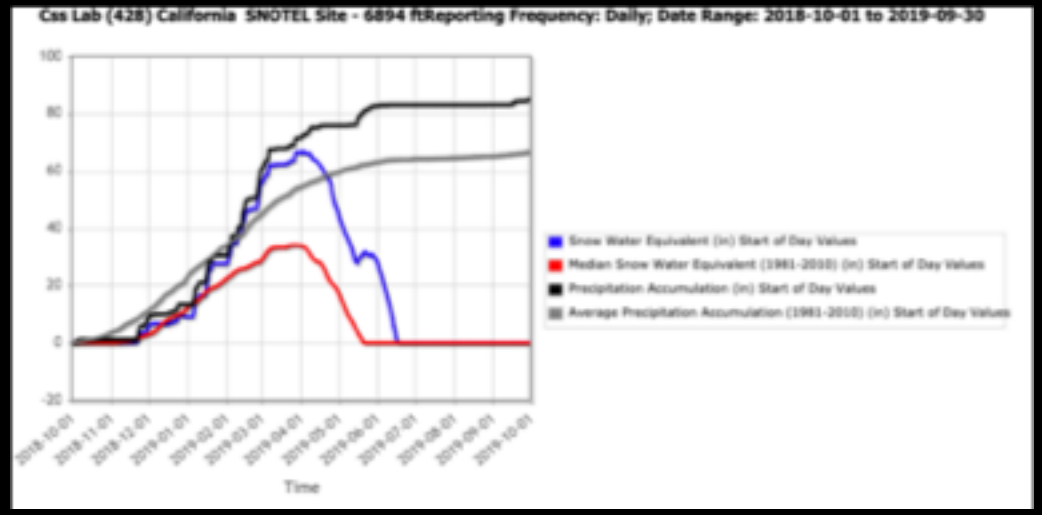
- Can miss the story of how the winter unfolded by just looking at April 1 SWE
- Track daily values throughout the year
- SWE and precipitation phase diagram

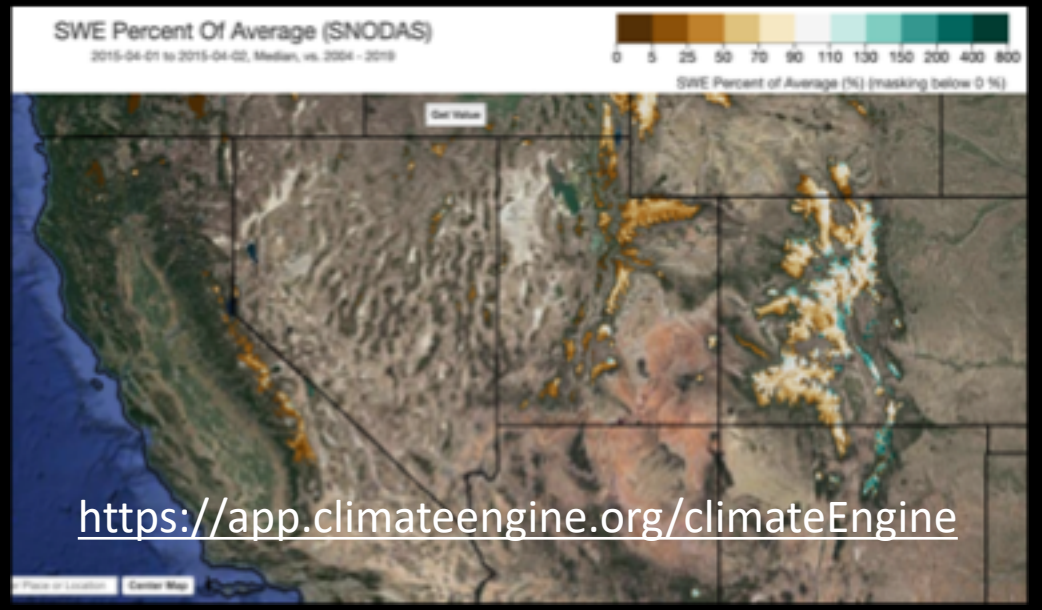
Filling a gap in snow drought tracking



https://www.wcc.nrcs.usda.gov/snow/

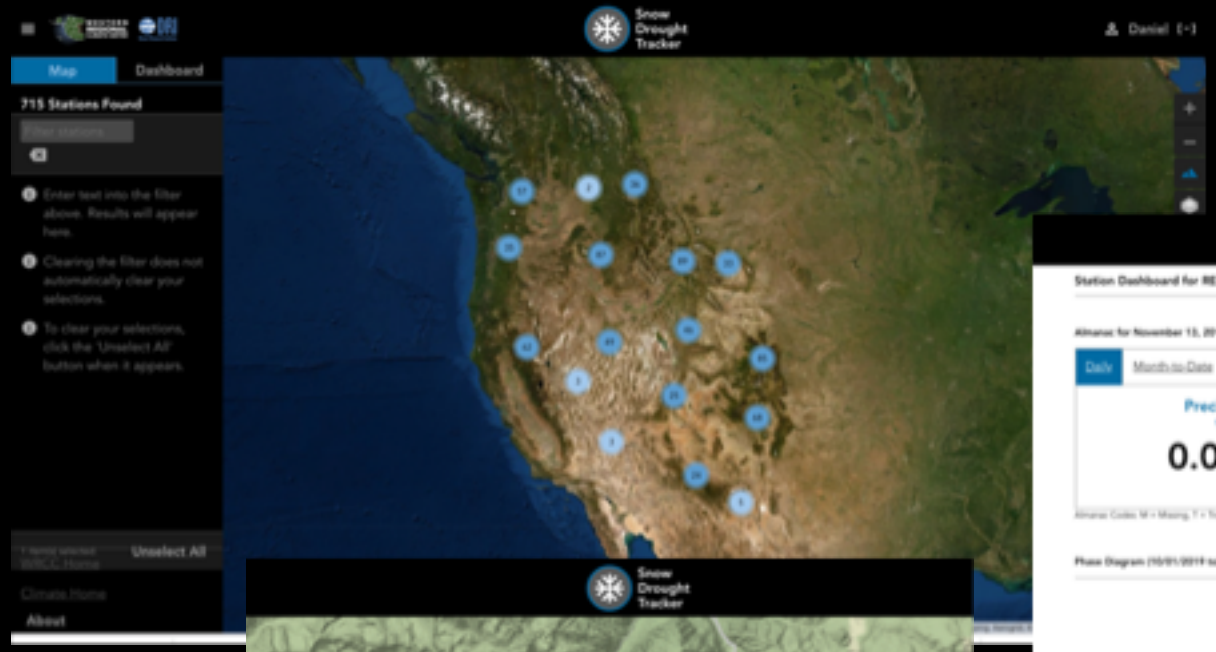
- Current tools are lacking a quick look into where a given location sits in terms of classifying snow drought



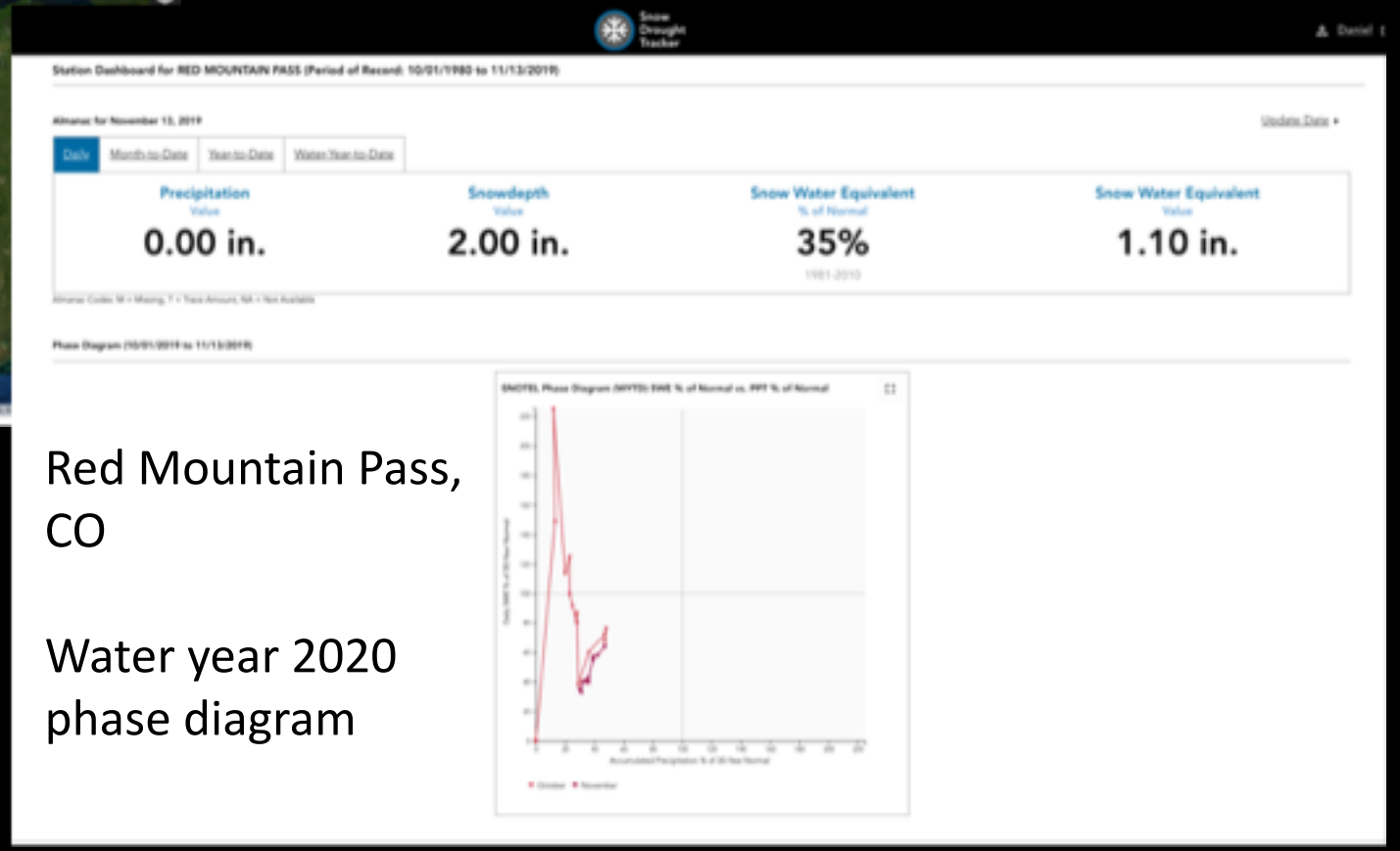


https://app.climateengine.org/climateEngine

Snow Drought Tracker Web Application



- NRCS SNOTEL Network

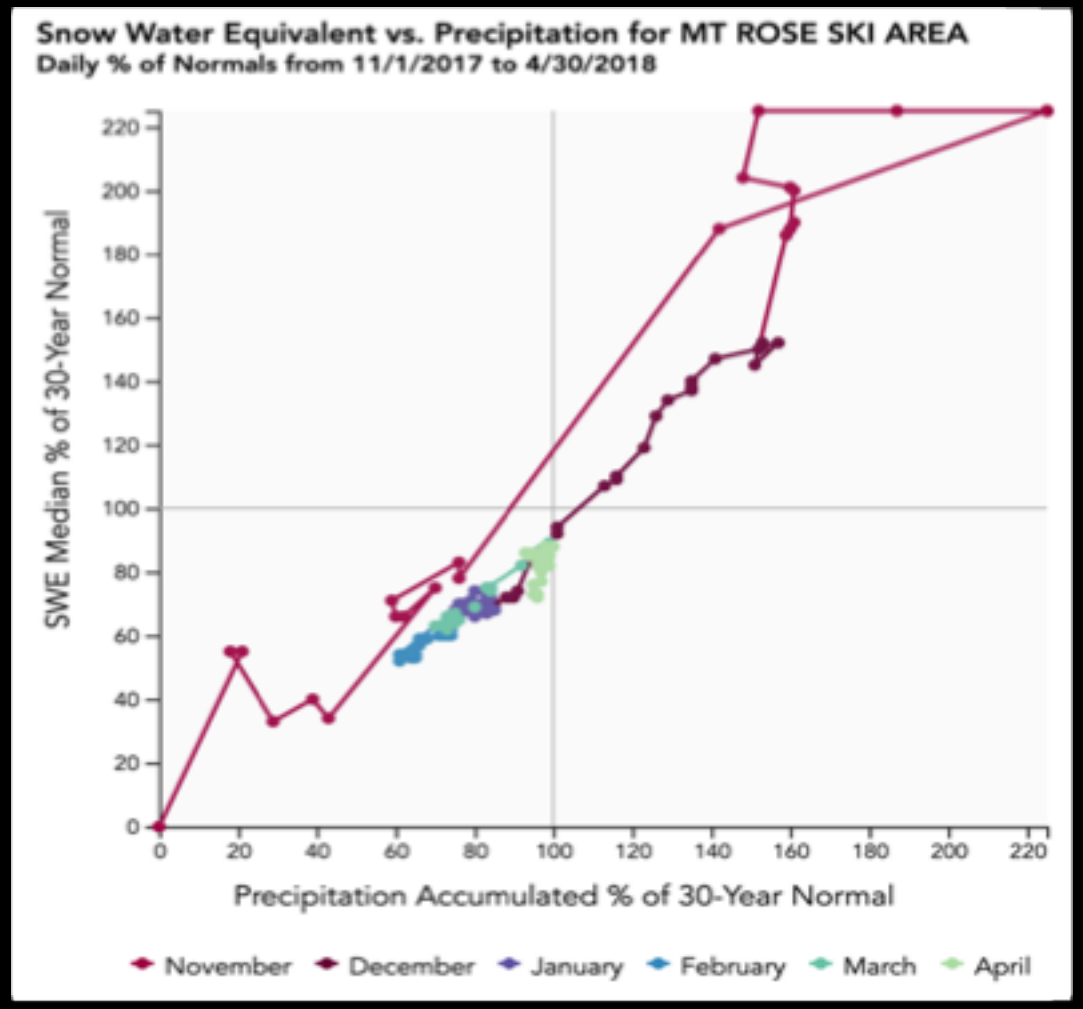


Red Mountain Pass, CO

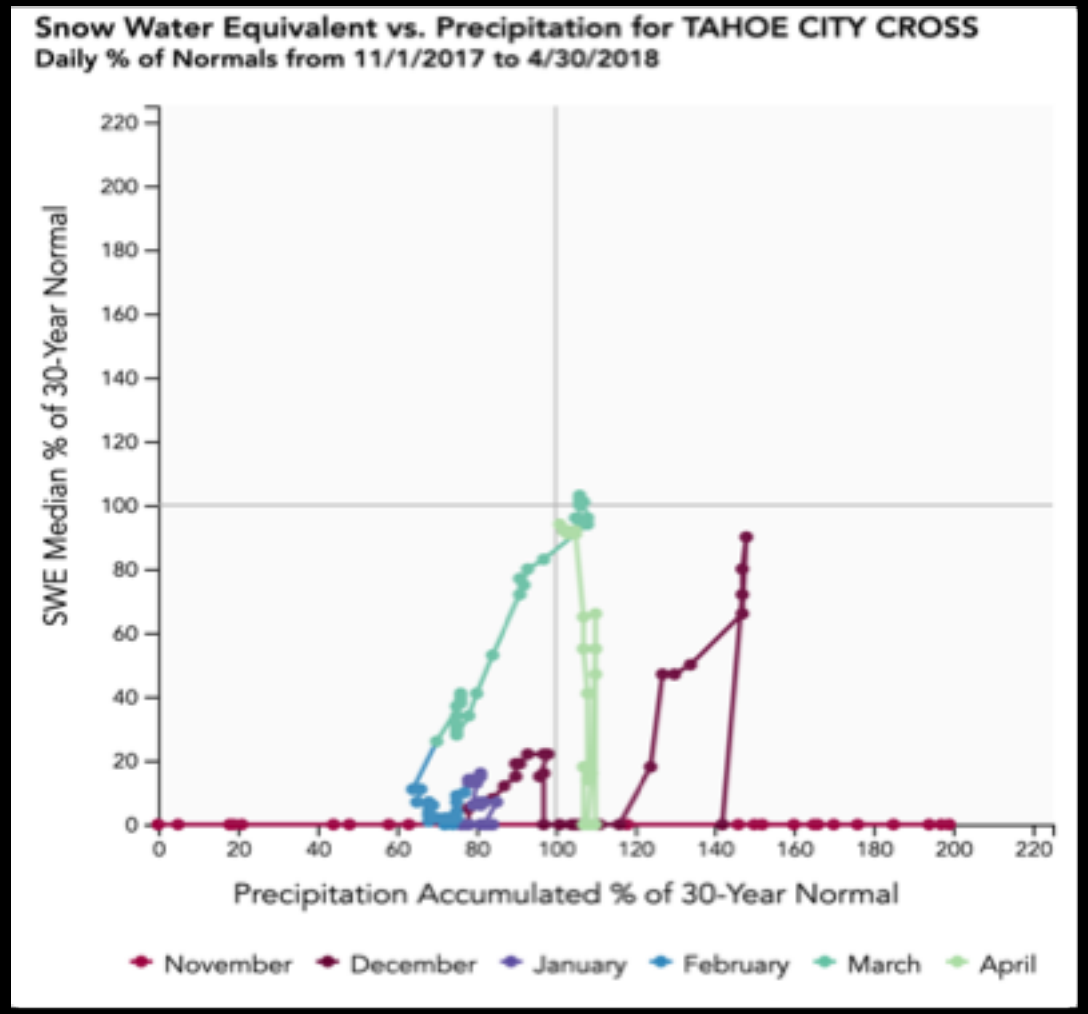
Water year 2020 phase diagram

A Tale of Two Northern Sierra Snow Drought in 2018

Mt Rose Ski Area, NV, 8801 ft. elevation

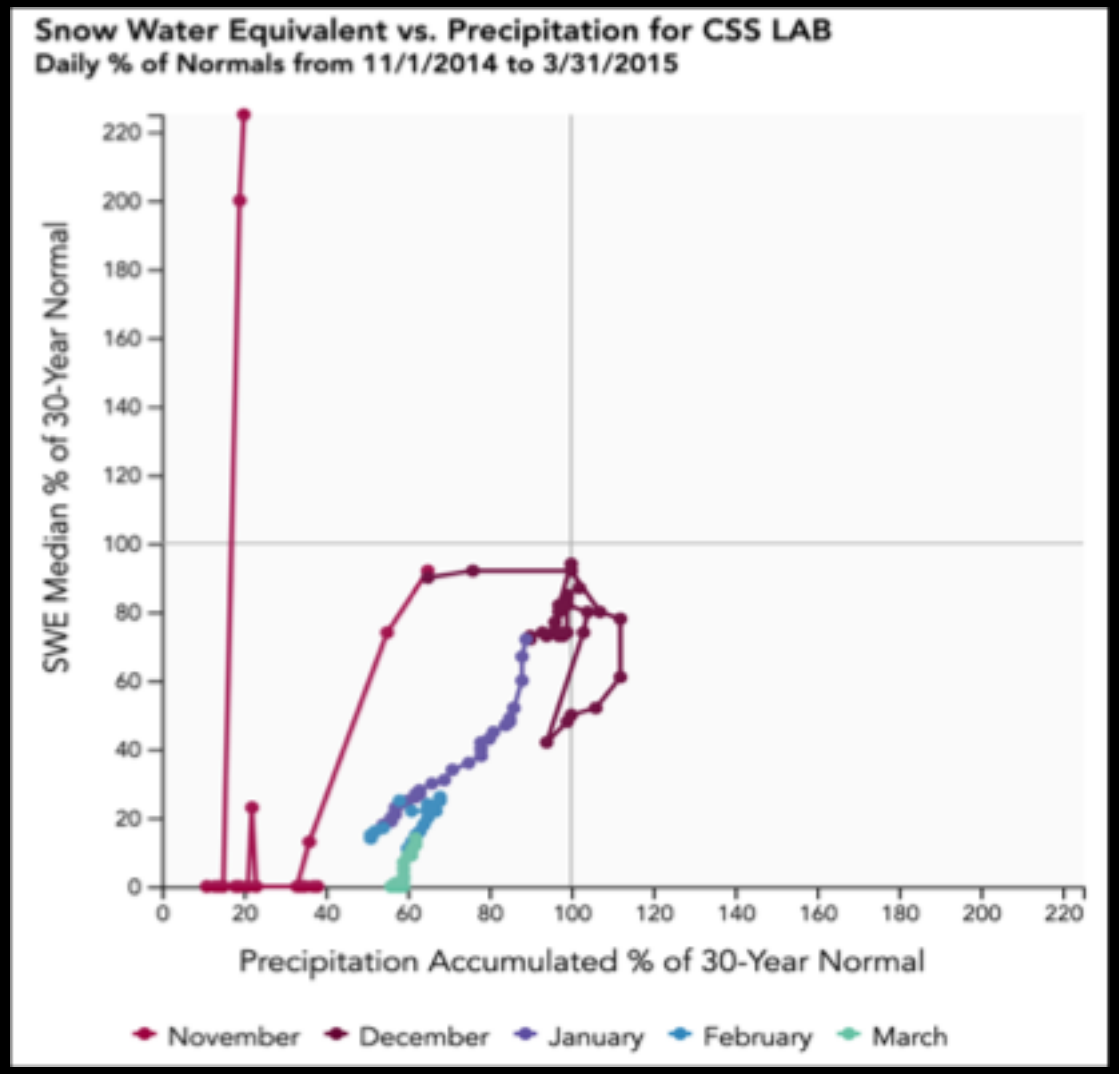


Tahoe City, CA, 6797 ft. elevation

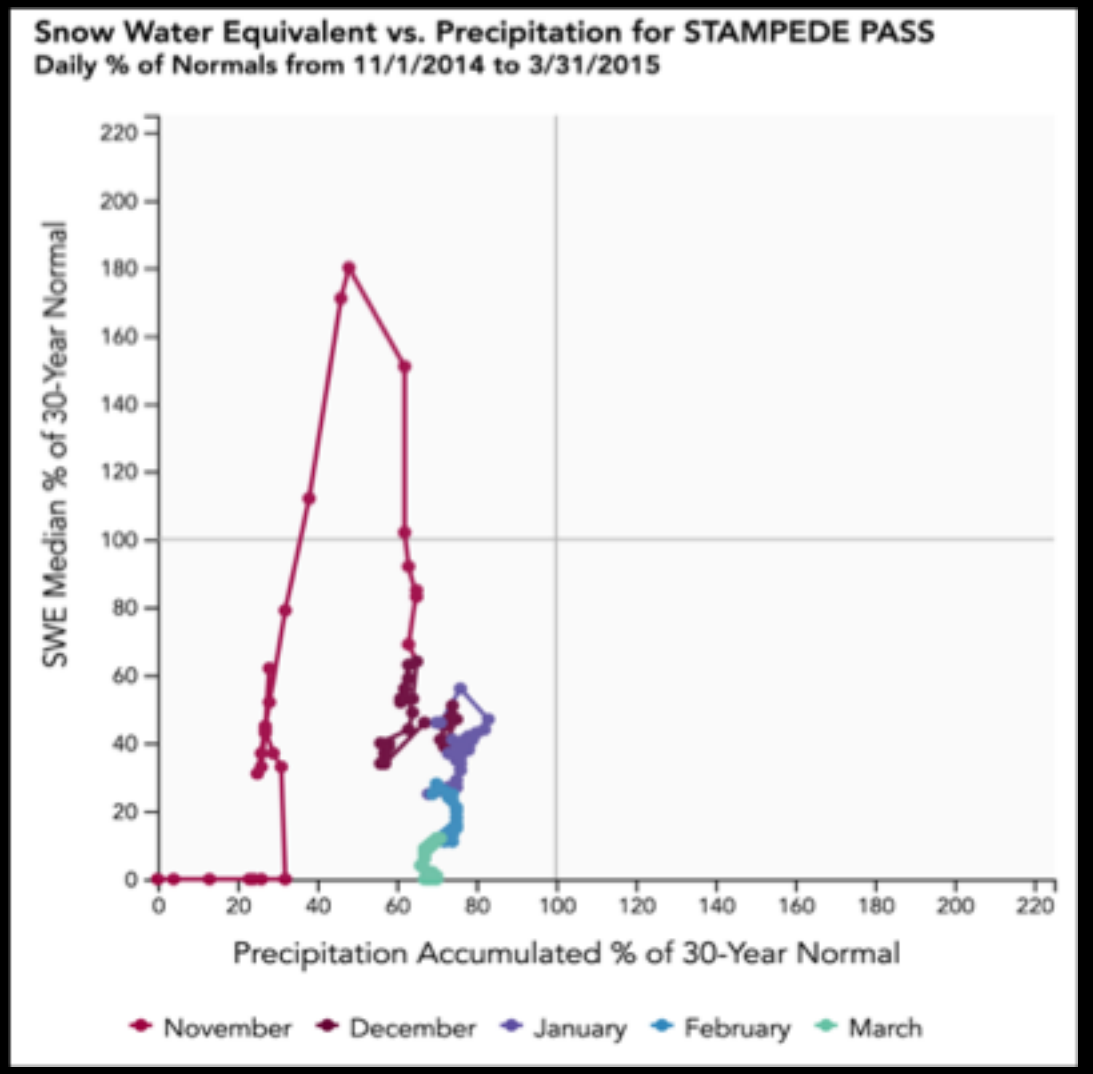


The Great Western Snow Drought of 2015

Central Sierra Snow Lab, CA

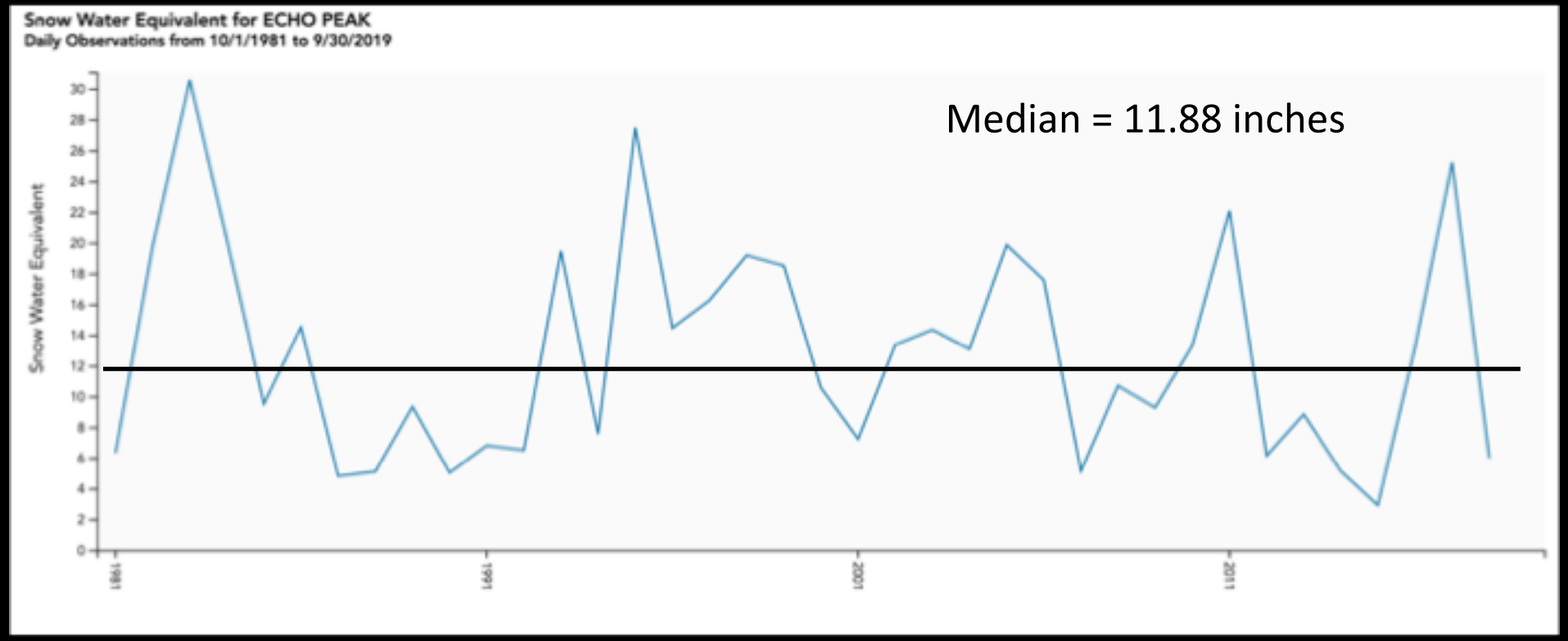


Stampede Pass, WA



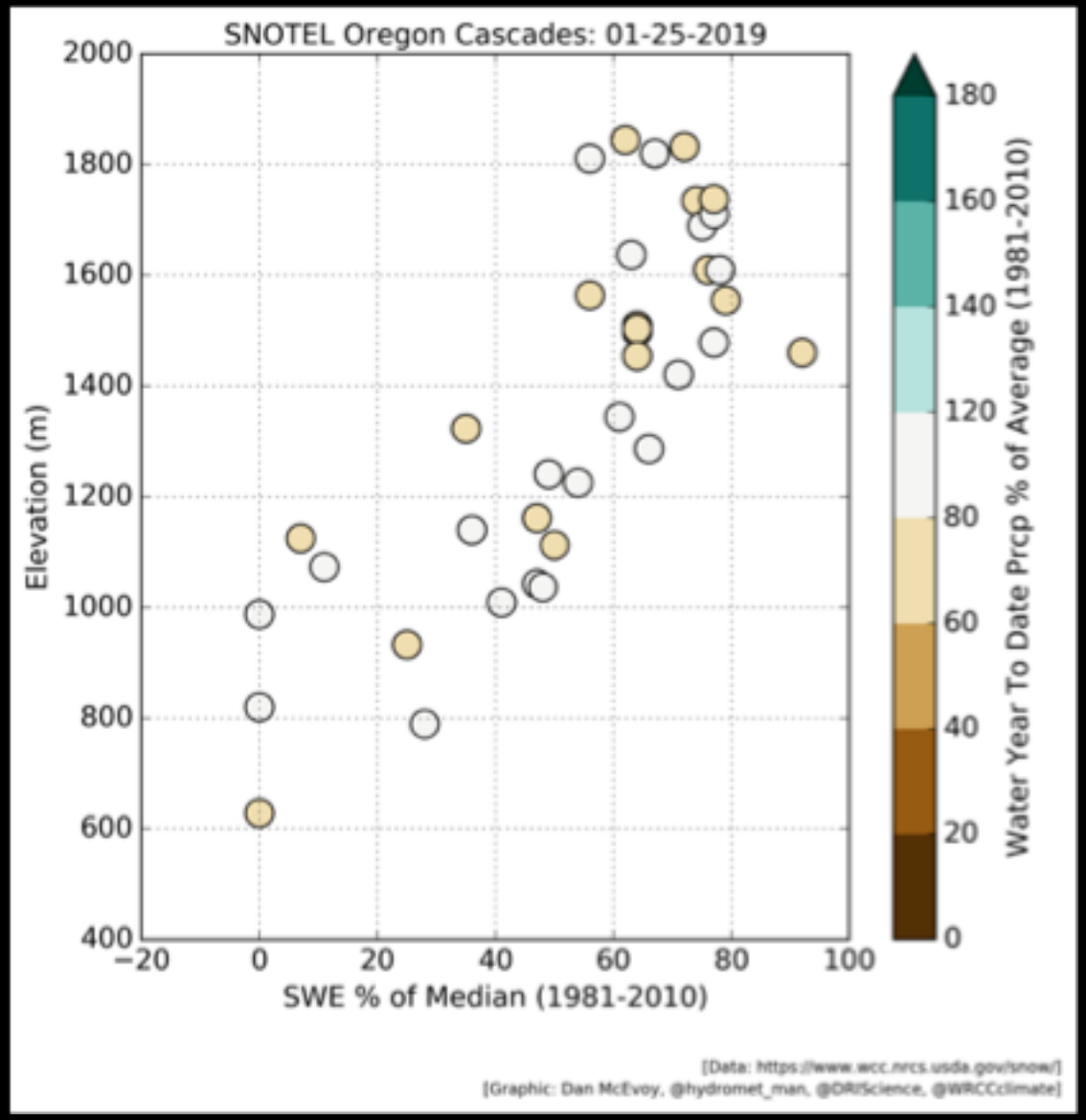
Time Series Features: Year-to-Year SWE Variability

Echo Peak, CA annual average SWE 1981-2018



- Changing this feature to a single date selector
- Example: time series of all December 31 SWE values in record

Tracking Snow Drought Elevation Gradients



- Still to come in v1.0: Large river basin (i.e., HUC 6) and mountain range tracking tools
- How does SWE vary by elevation within a watershed?
- Warm snow droughts often exhibit a strong decreasing SWE anomaly signal as elevation decreases within a basin

Project development and updates

- Release of beta v1.0 Snow Drought Tracker to public by January, 2020
- Still working to incorporate basin scale analysis into v1.0 and fine tune the phase diagram and time series tools

- National Weather Service funding beginning in 2020:
  - Testing of web application by NWS and other stakeholders
  - Incorporate feedback and new features into v2.0
  - Incorporate other data sources outside of NRCS SNOTEL including the California Cooperative Snow Survey real-time daily snow pillow data

  - What additional features would you like to see added?

- Link the Snow Drought Tracker to the NIDIS snow drought page: https://www.drought.gov/drought/data-maps-tools/snow-drought

- Big thanks to the DRI Foundation Innovative Research Program for funding this project!

Thank you!
Questions?
mcevoyd@dri.edu
Mt. Rose backcountry
January 26, 2019
Photo: Dan McEvoy