

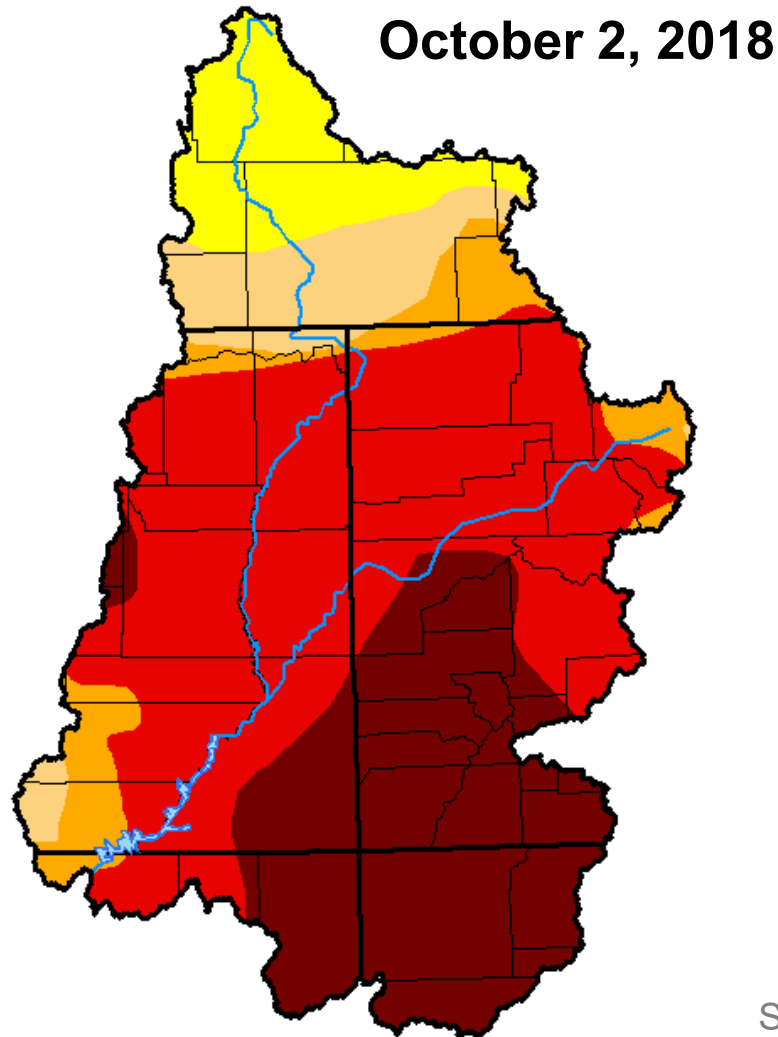
Snowpocalypse

A 2019 feast after a 2018 famine

2019 Annual Seminar
Colorado River District
Grand Junction, CO – September 18, 2019
Jeff Lukas, Western Water Assessment
CIRES, University of Colorado Boulder

Image: Shaune Goleman

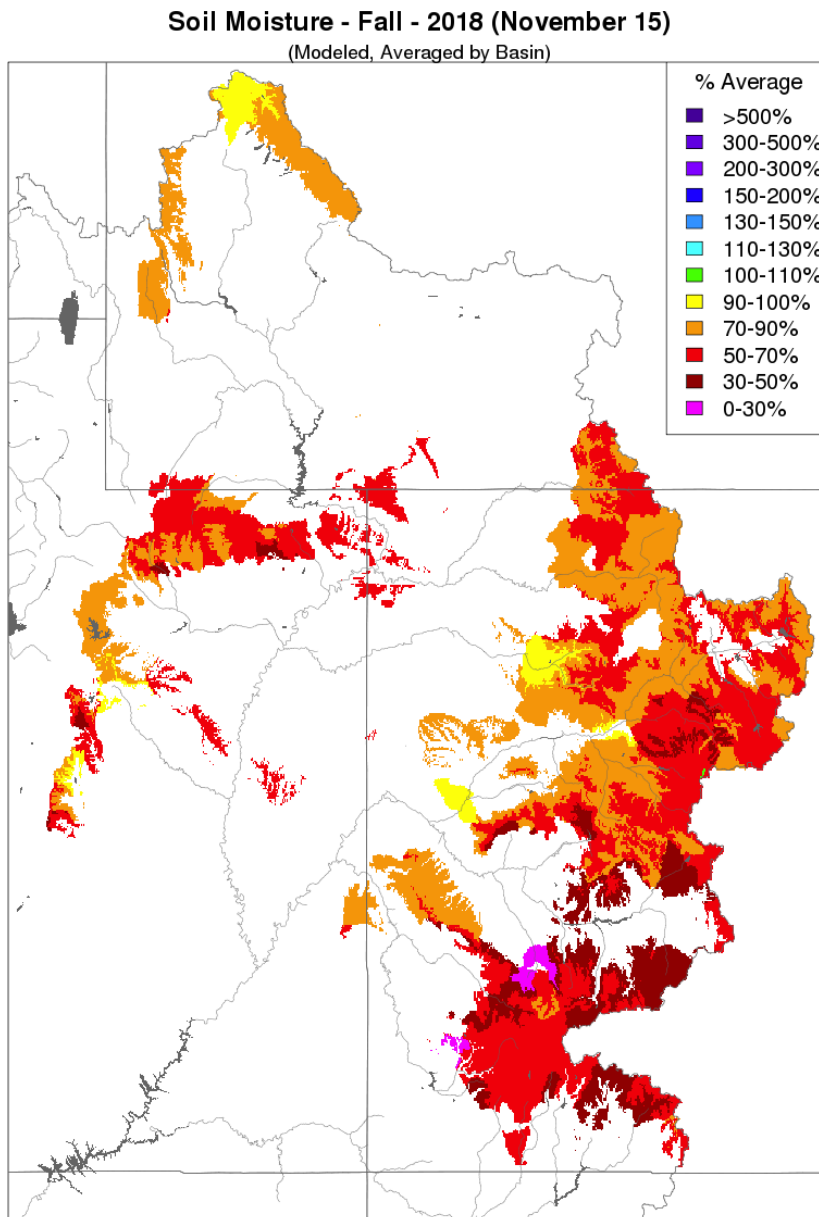
US Drought Monitor for Upper Colorado River Basin



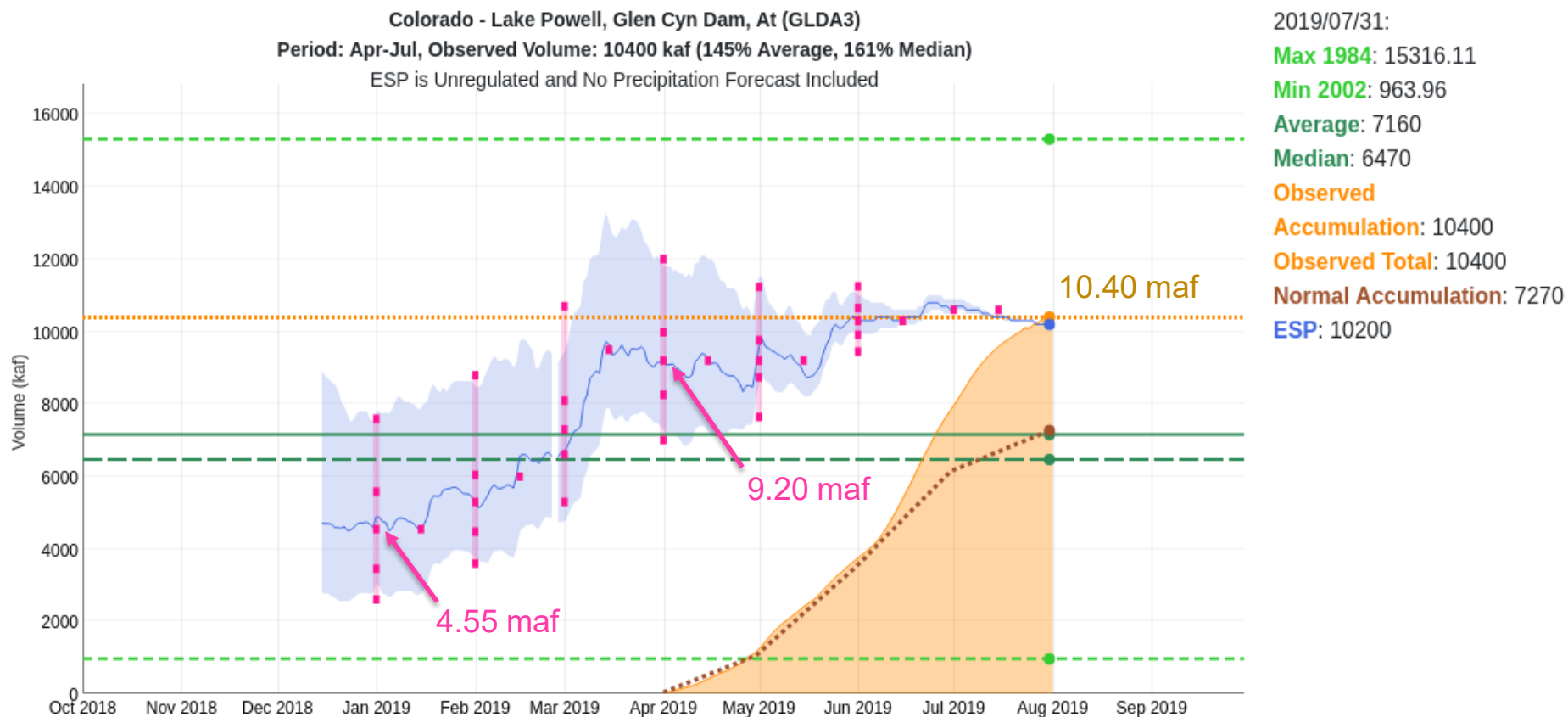
Source: US Drought Monitor;
<https://droughtmonitor.unl.edu/>

CBRFC modeled antecedent soil moisture – Nov 2018

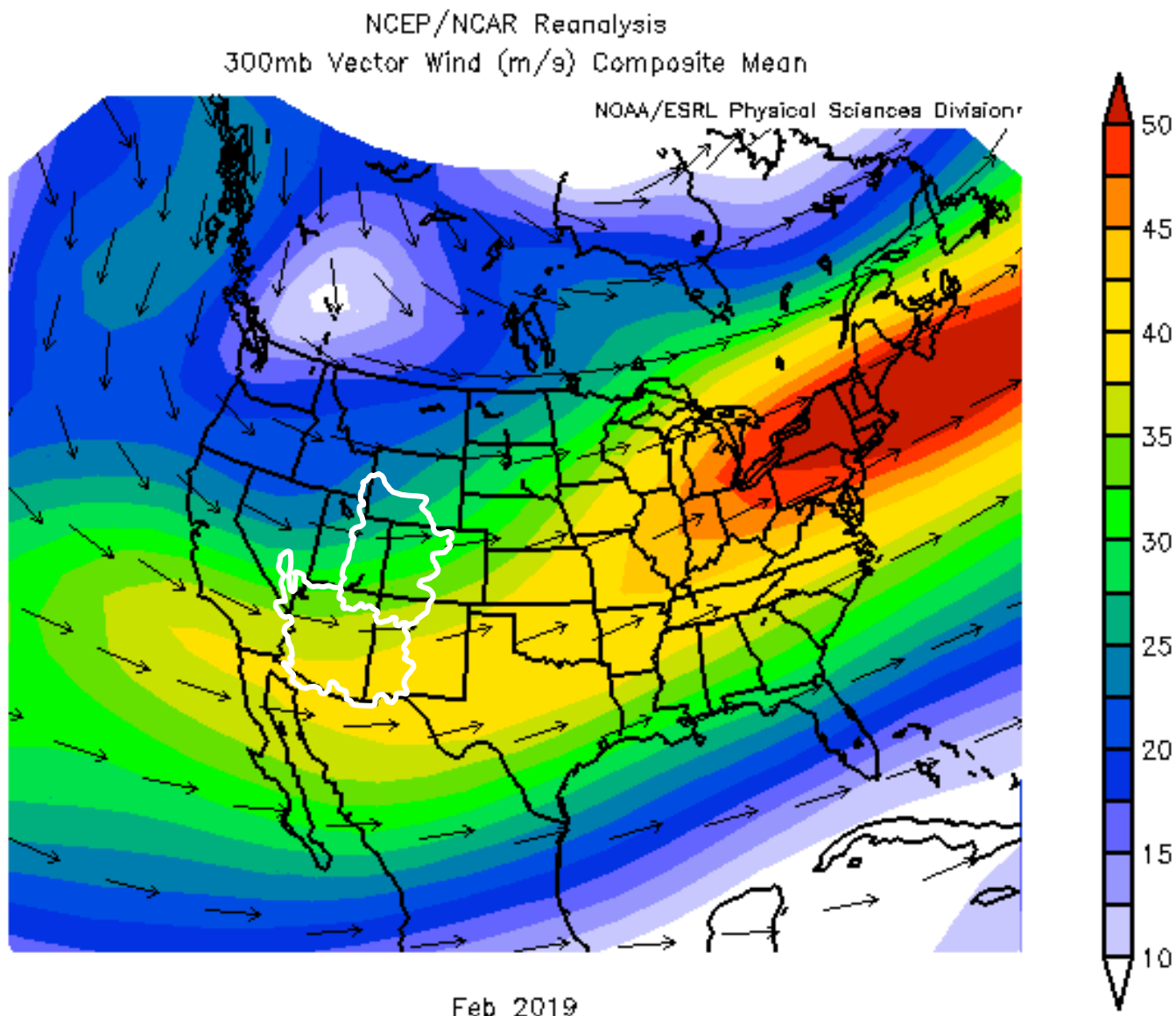
- Much below normal almost everywhere in Upper Basin
- Near-record-low in San Juan and Gunnison basins



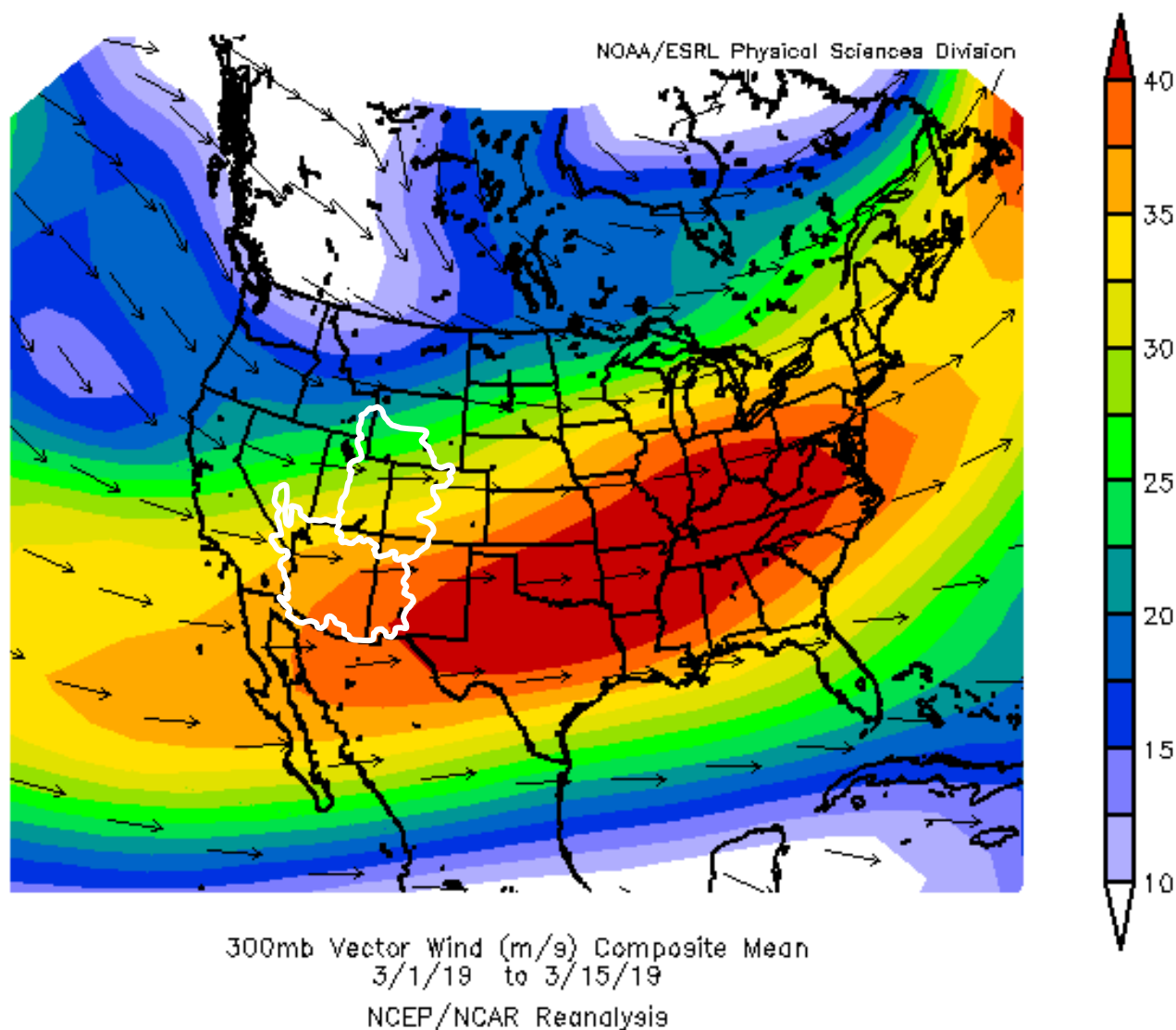
CBRFC forecast evolution plot – Lake Powell Apr-Jul inflows



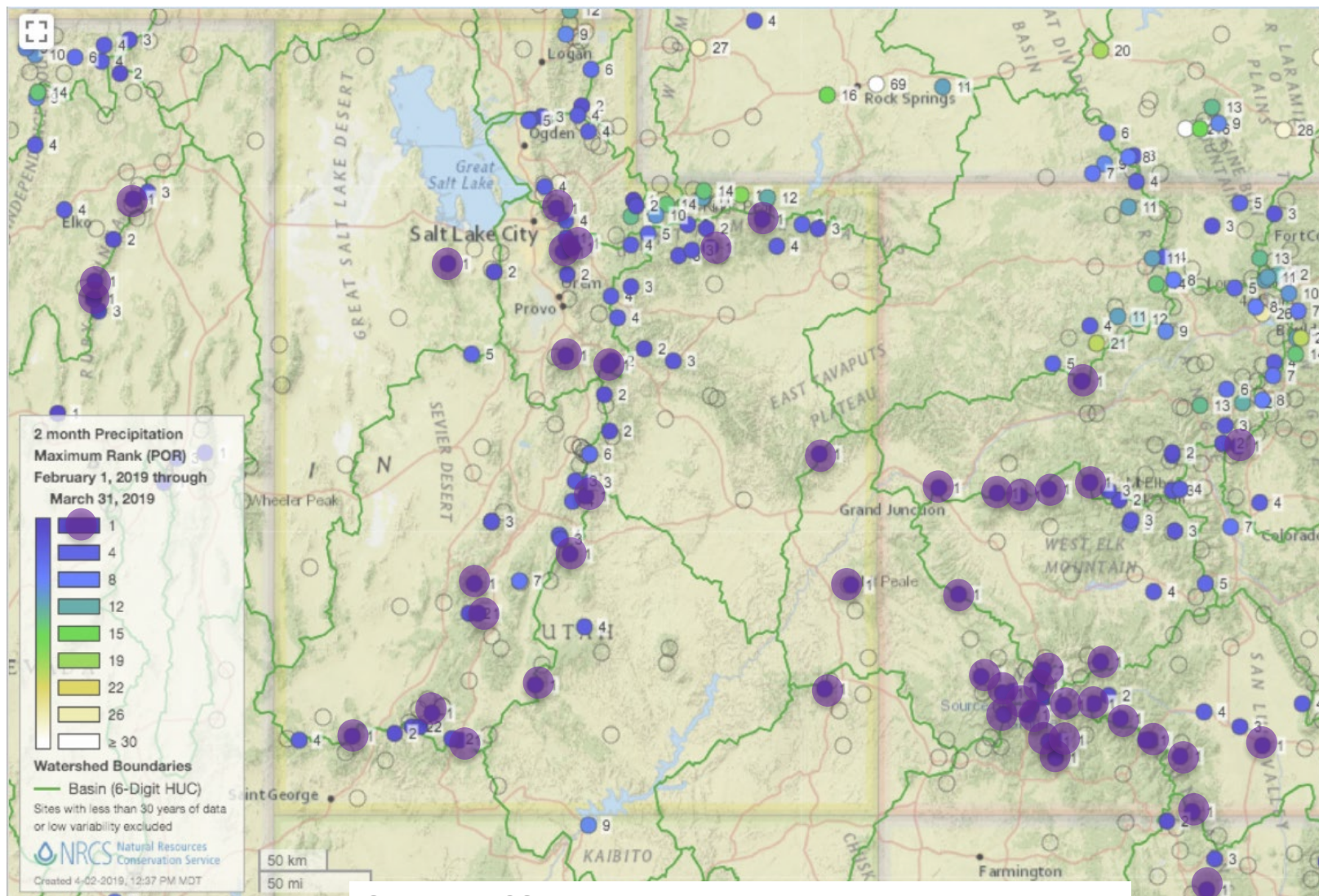
February – persistent trough, favorable flow



March 1st-15th – persistent trough, favorable flow



Rank of Feb-Mar 2019 precip at SNOTEL sites



Source: NRCS Interactive Map;
<https://www.nrcs.usda.gov/wps/portal/wcc/home/quicklinks/imap>

“Historic” avalanche cycle in early March in CO mts

From February 28th

- March 10th:

- 10-15 feet of snow
- 6”-12” of SWE
- Avalanche activity not seen since 1950s

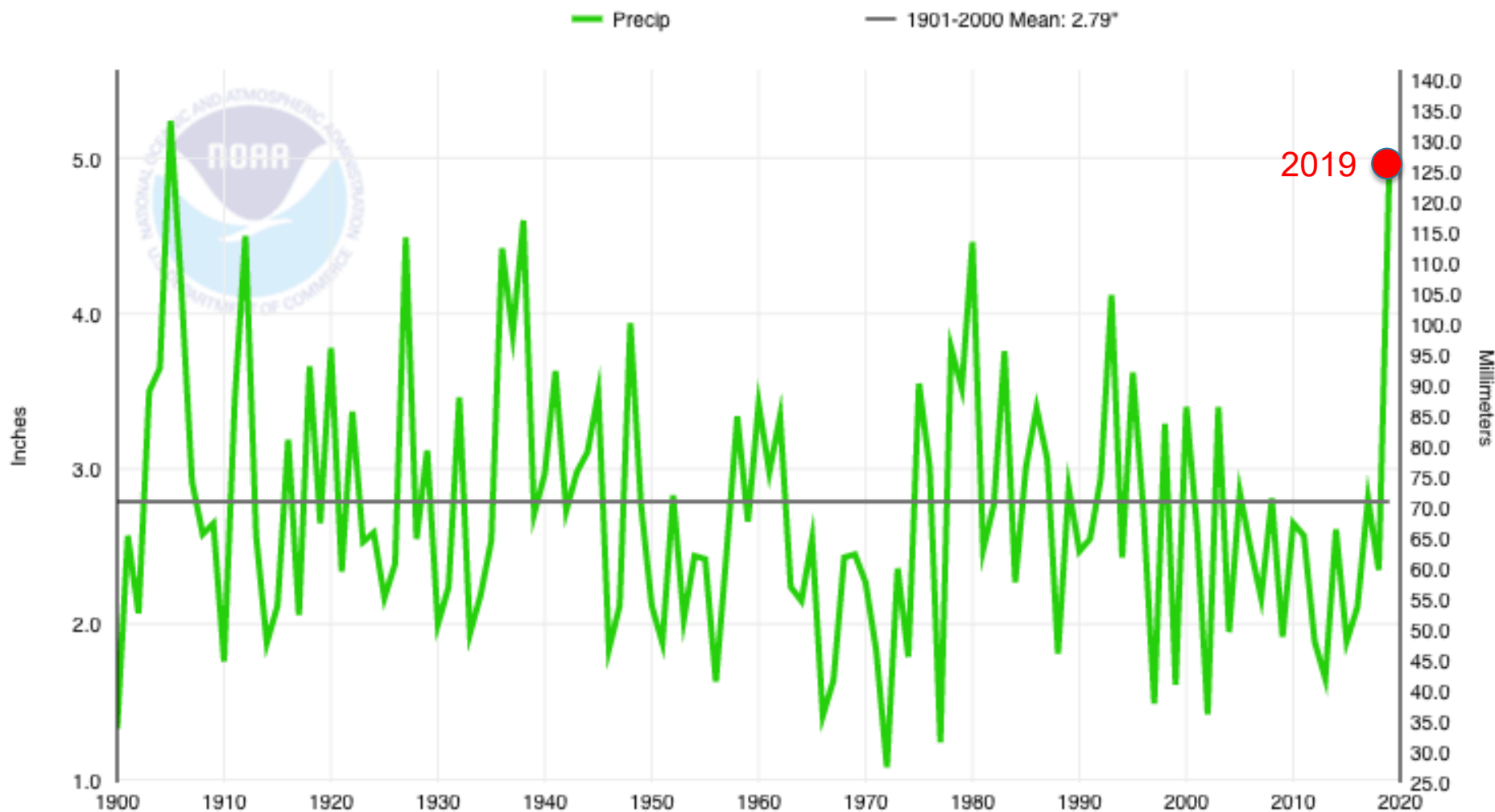


Conundrum Creek slide down Highlands Ridge, Aspen

Source: Colorado Avalanche Information Center, from Telluride Helitrax

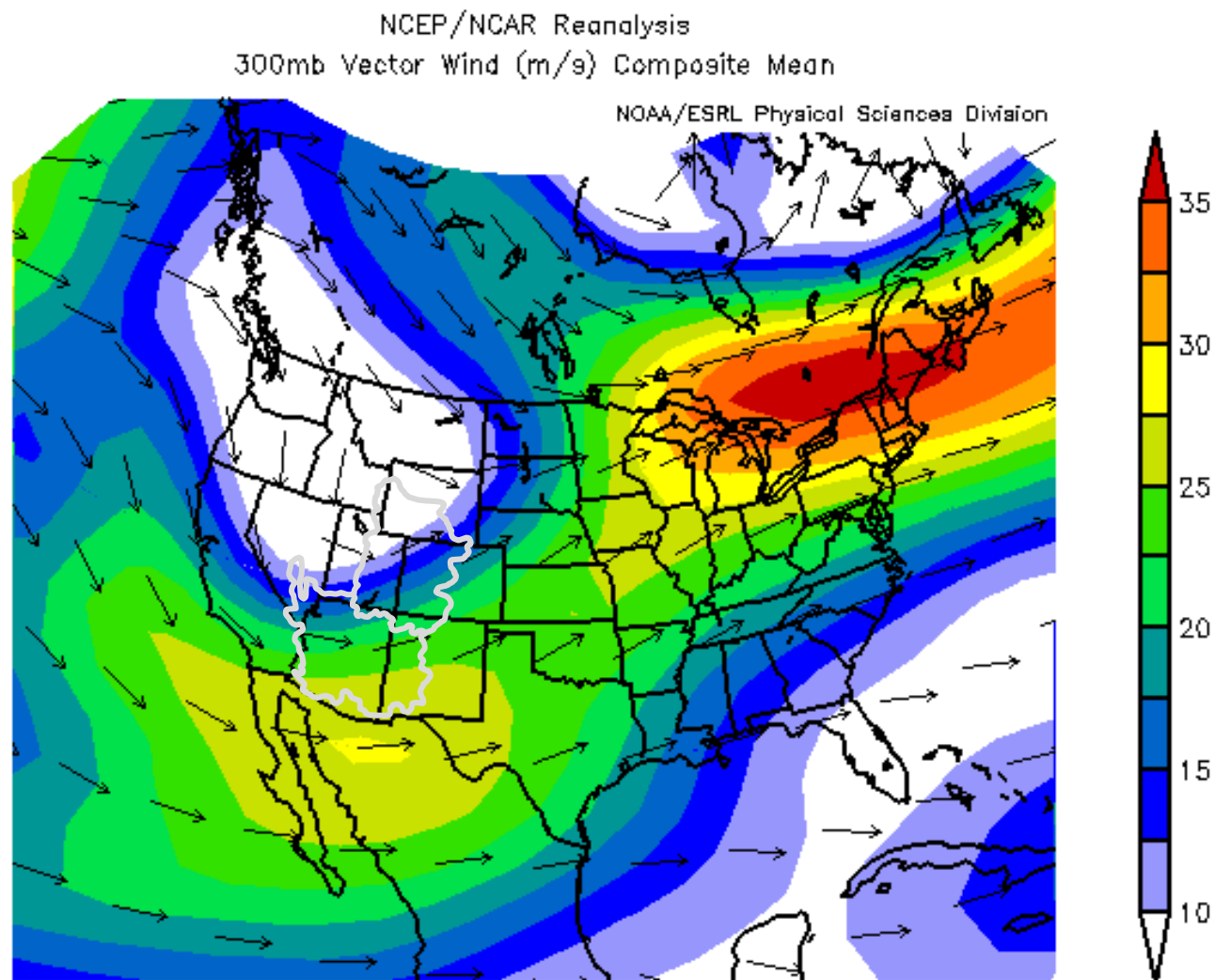
Feb-Mar Upper Basin precip, 1900-2019

Area-Weighted Upper Colorado River Basin, Precipitation, February-March



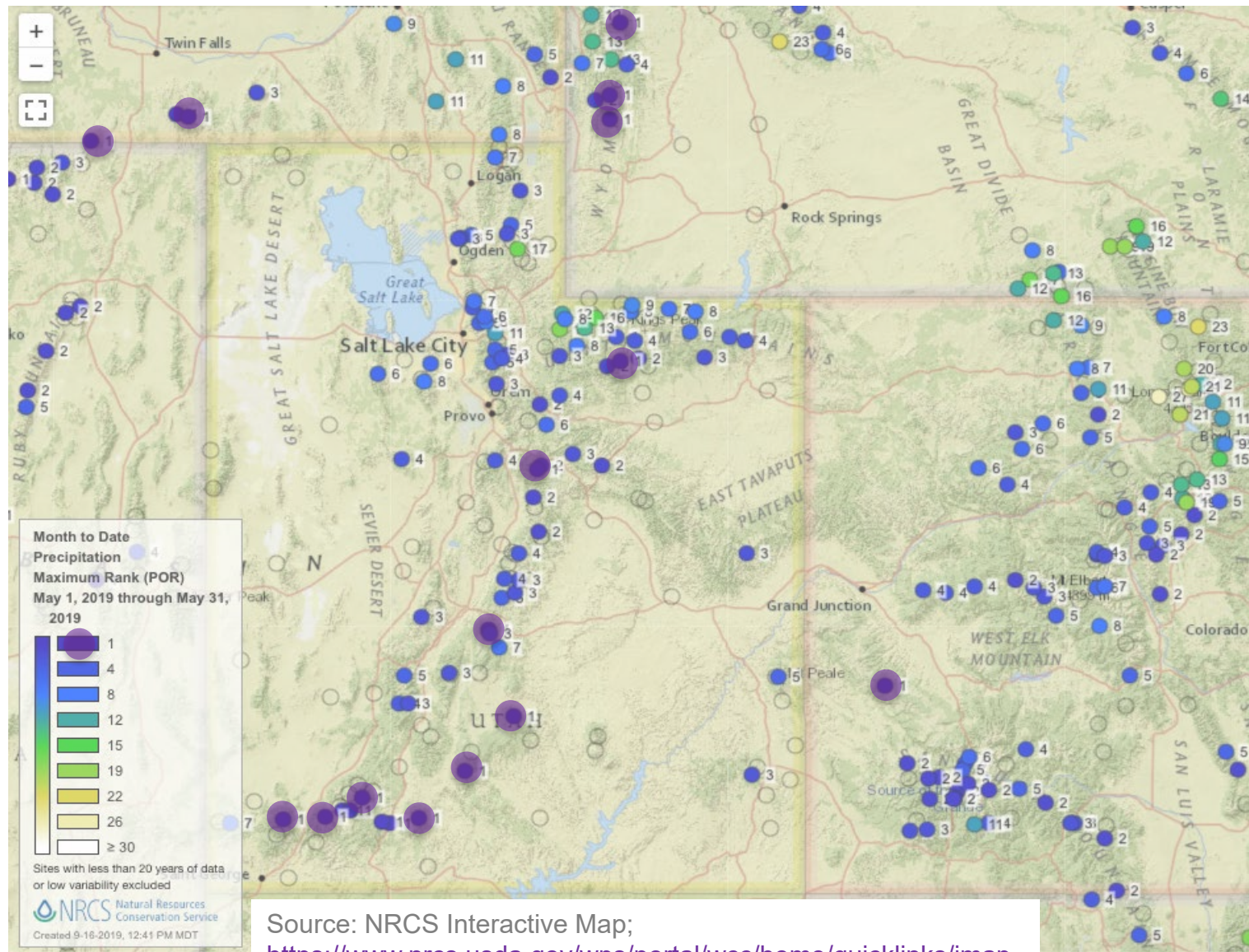
Source: NOAA NCEI Climate at a Glance; <https://www.ncdc.noaa.gov/cag/>

May – very deep trough, favorable flow



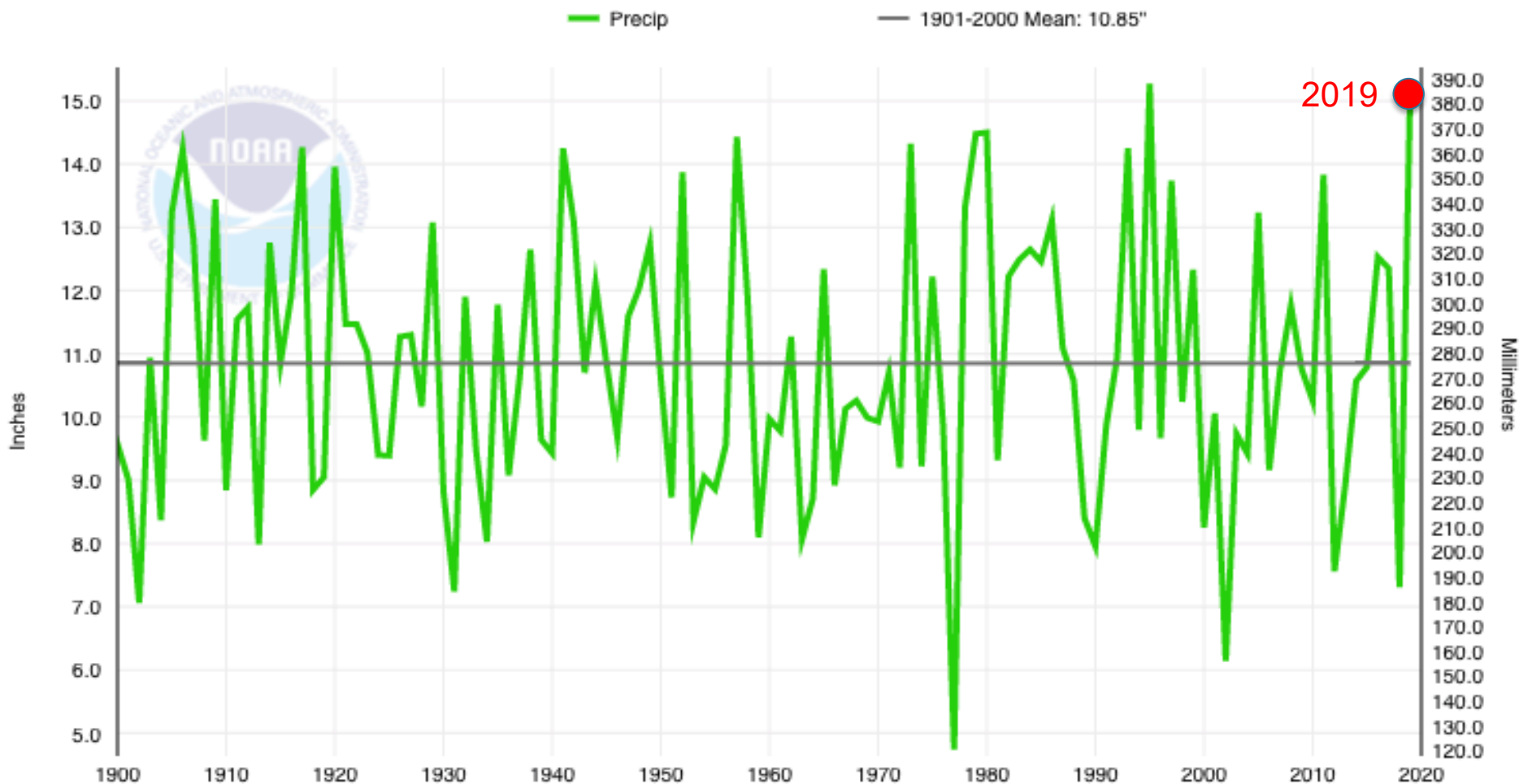
May 2019

Rank of May 2019 precip at SNOTEL sites



Oct-May Upper Basin precip: 2019 2nd highest since 1900

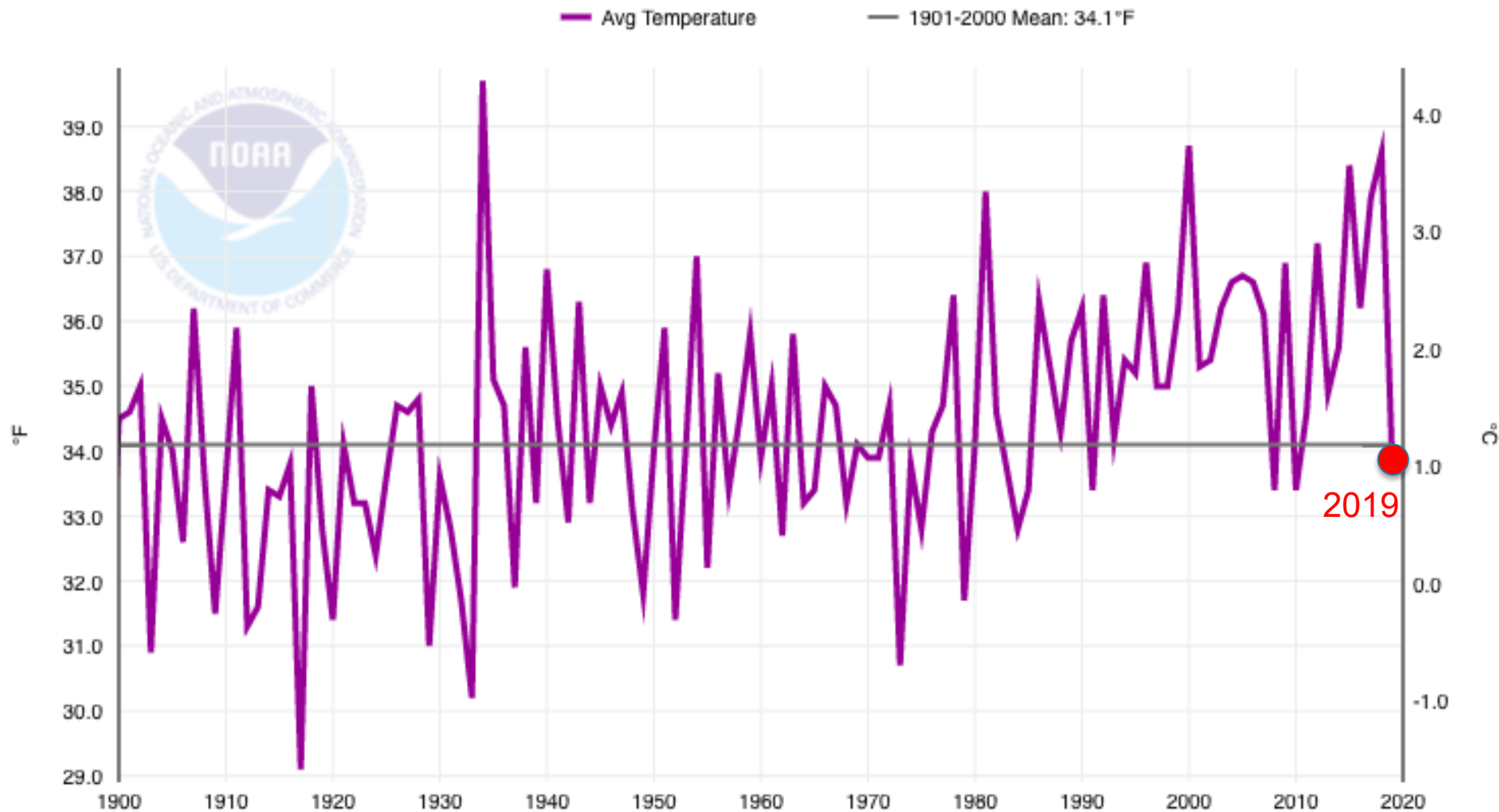
Area-Weighted Upper Colorado River Basin, Precipitation, October-May



Source: NOAA NCEI Climate at a Glance; <https://www.ncdc.noaa.gov/cag/>

Oct-May Upper Basin temps: 2019 coolest since 2010

Area-Weighted Upper Colorado River Basin, Average Temperature, October-May

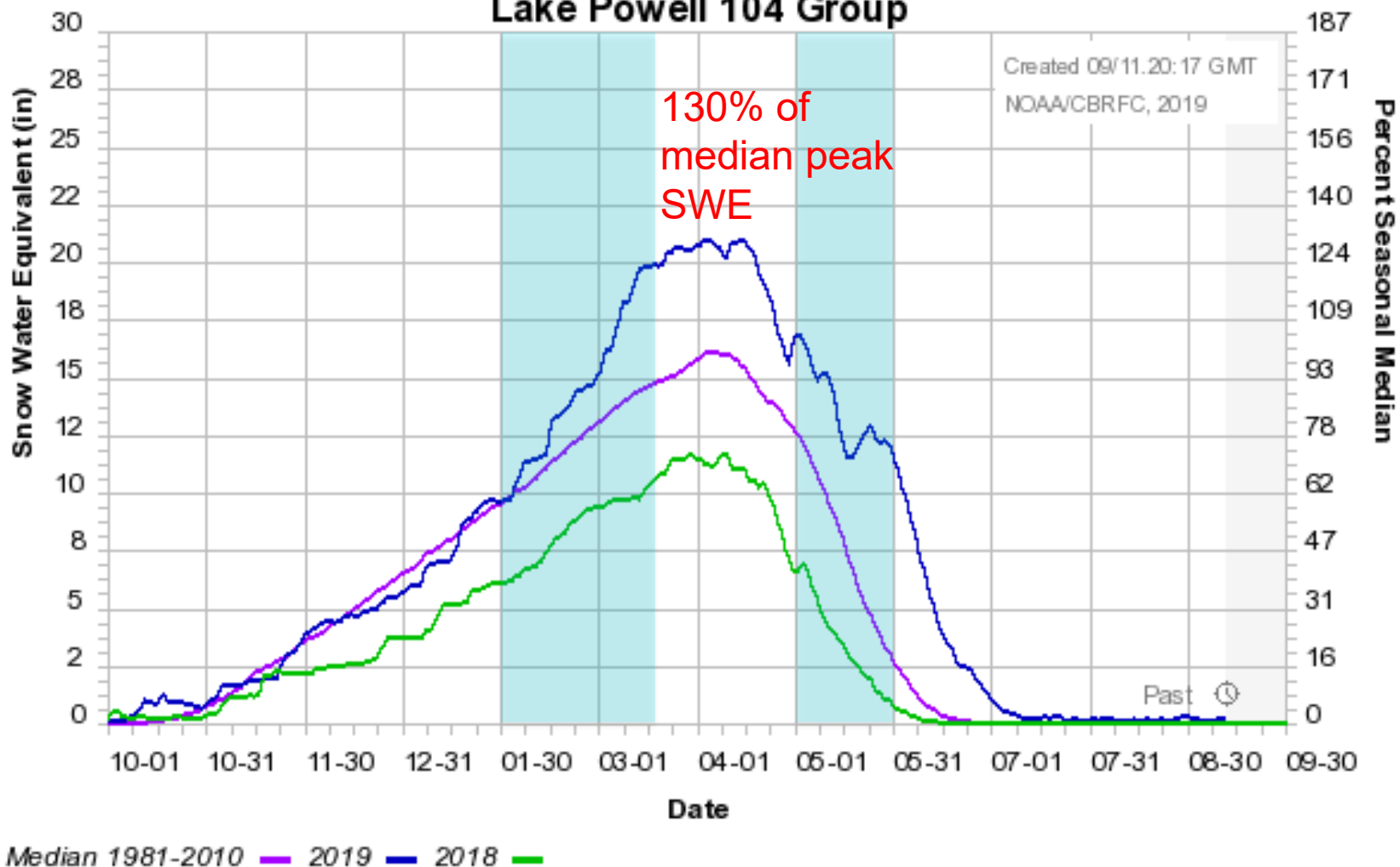


Source: NOAA NCEI Climate at a Glance; <https://www.ncdc.noaa.gov/cag/>

WY 2019 SWE plot –Lake Powell 104 Group

Colorado Basin River Forecast Center

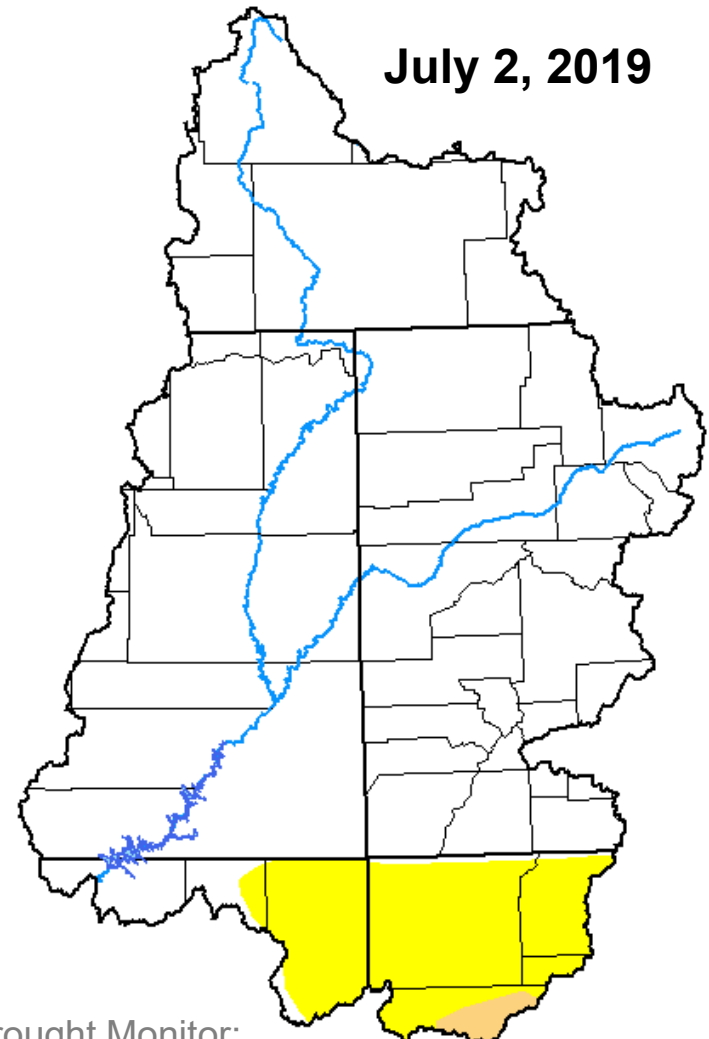
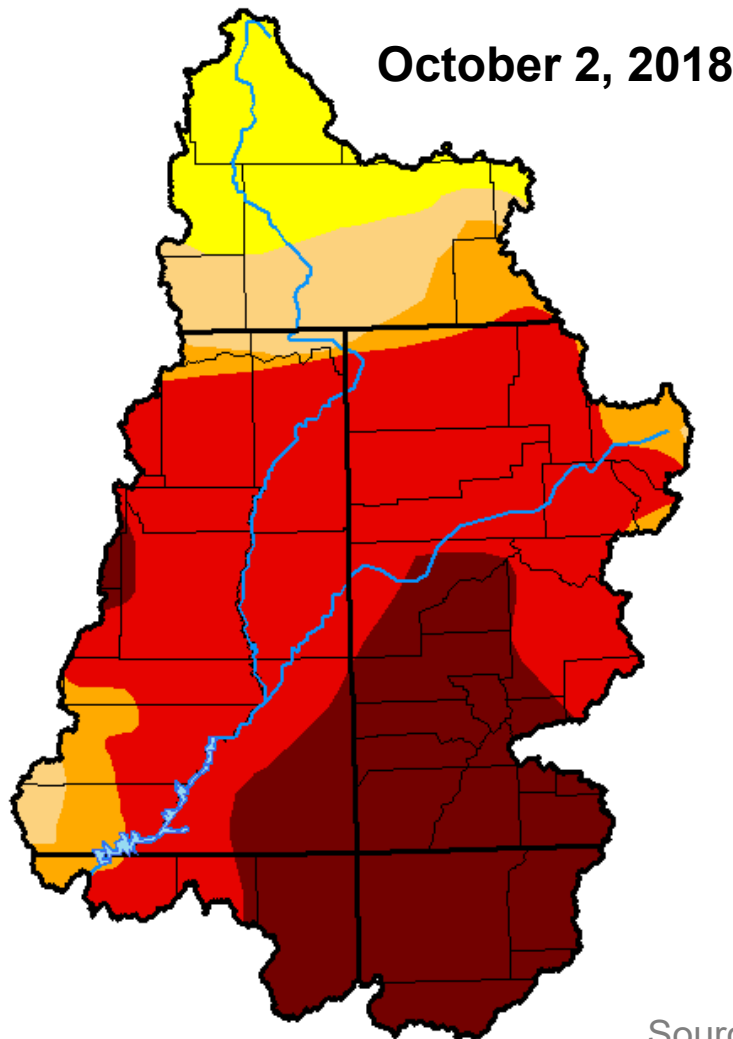
Lake Powell 104 Group



Source: NOAA CBRFC;

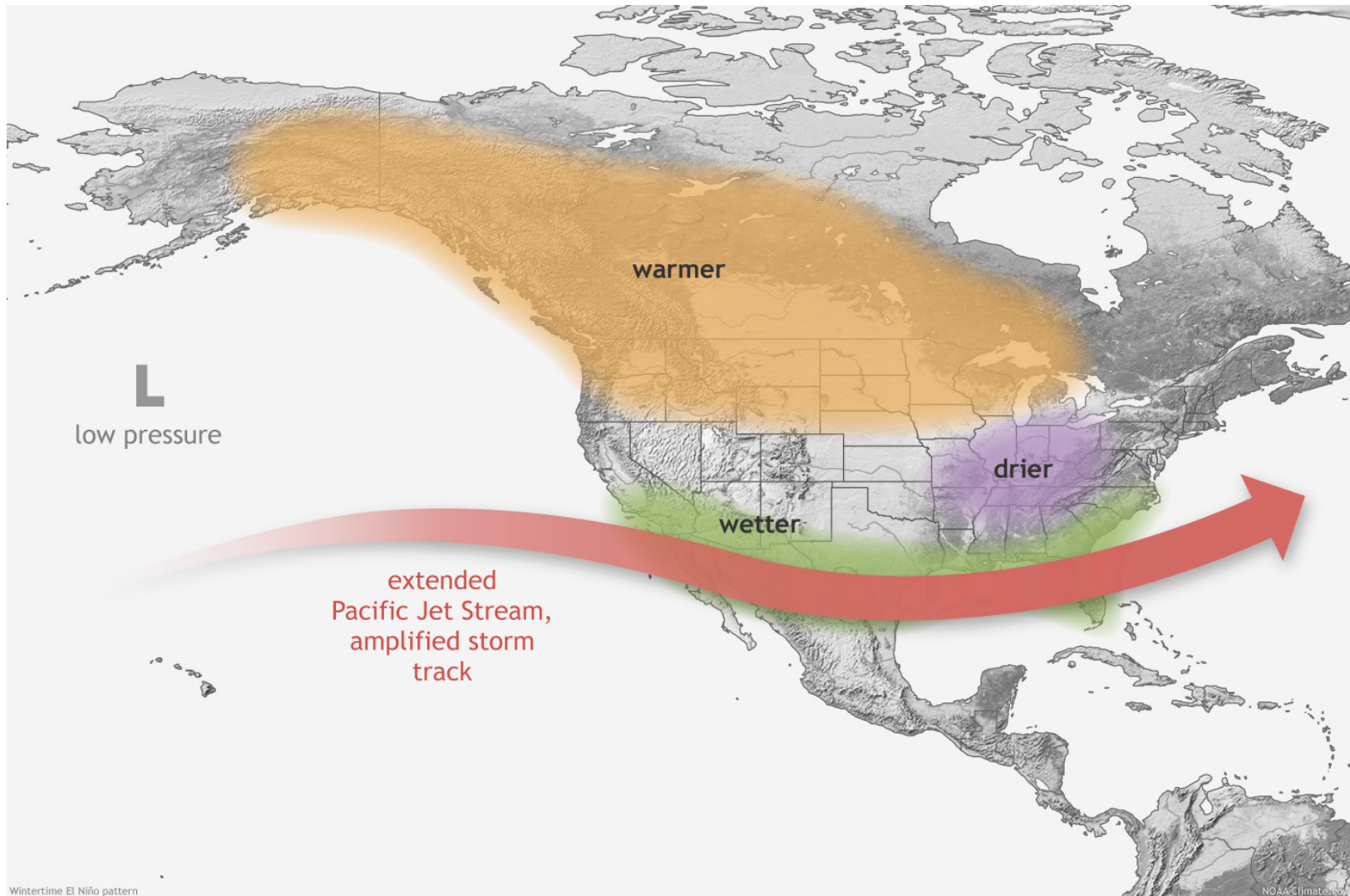
<https://www.cbrfc.noaa.gov/station/sweplot/snowgroup.php>

US Drought Monitor for Upper Colorado River Basin

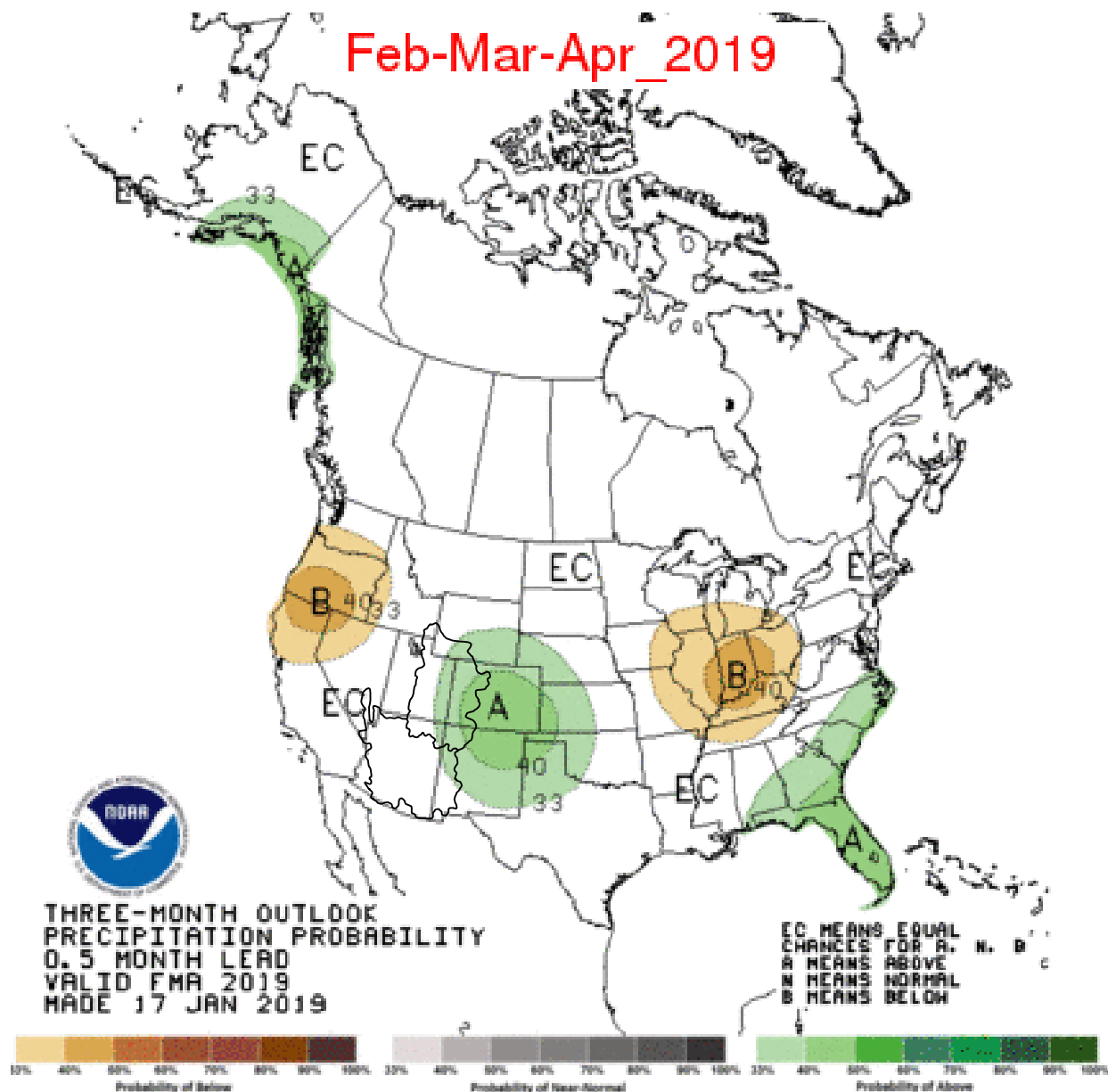


Source: US Drought Monitor;
<https://droughtmonitor.unl.edu/>

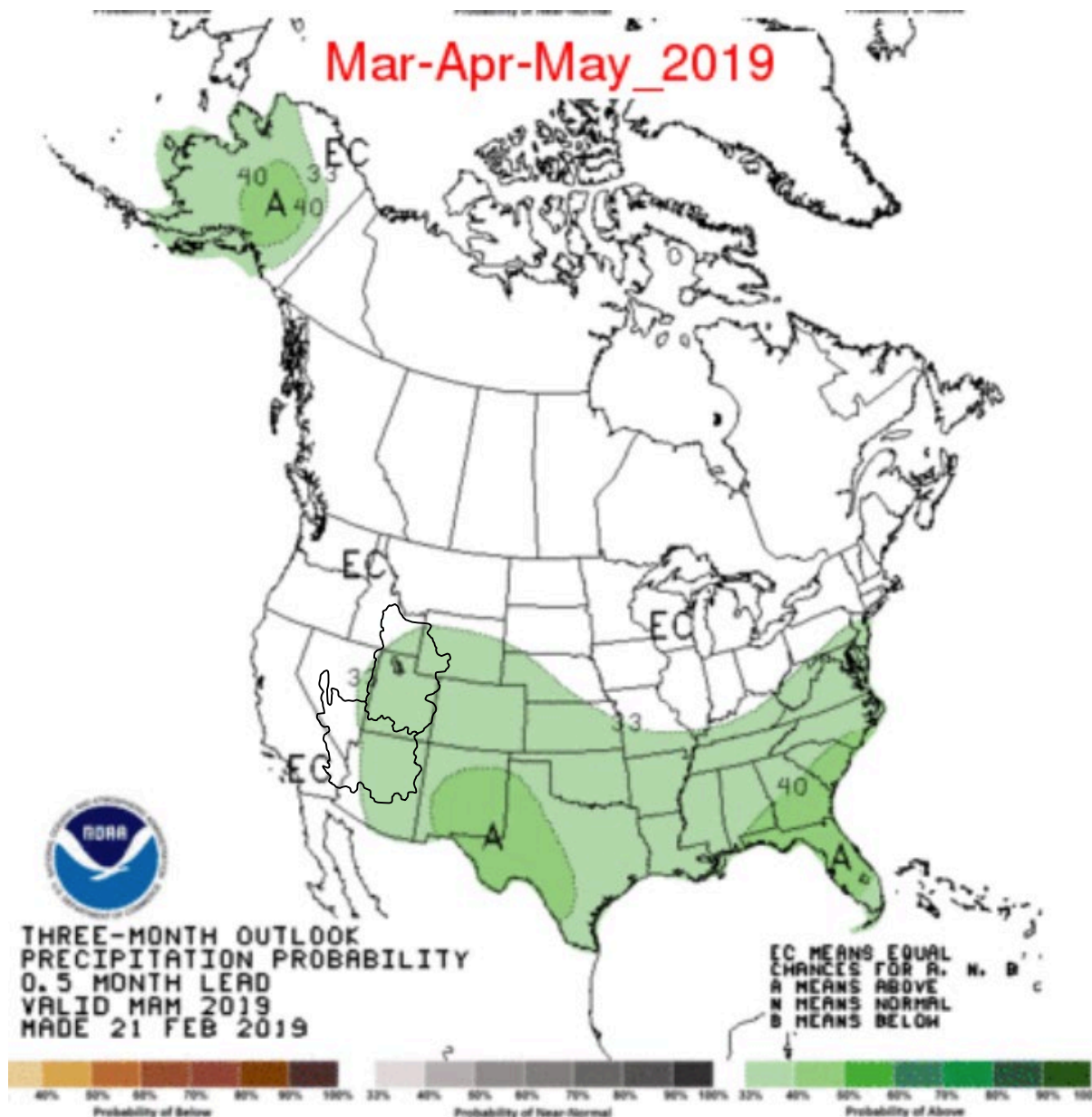
Schematic of typical winter El Niño effects on U.S.



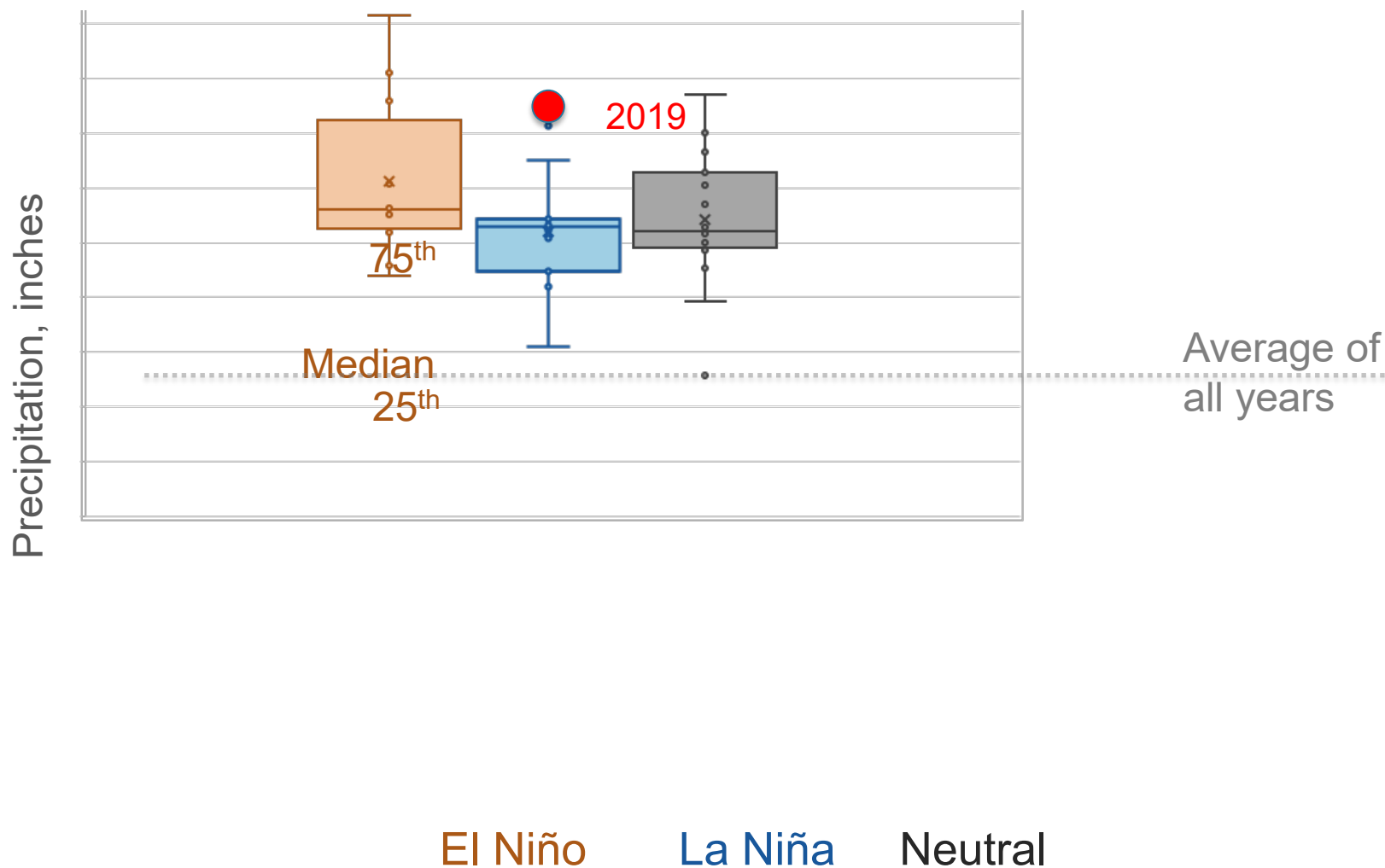
CPC seasonal outlook for Feb-Apr, issued Jan 17th



CPC seasonal outlook for Mar-May, issued Feb 21st

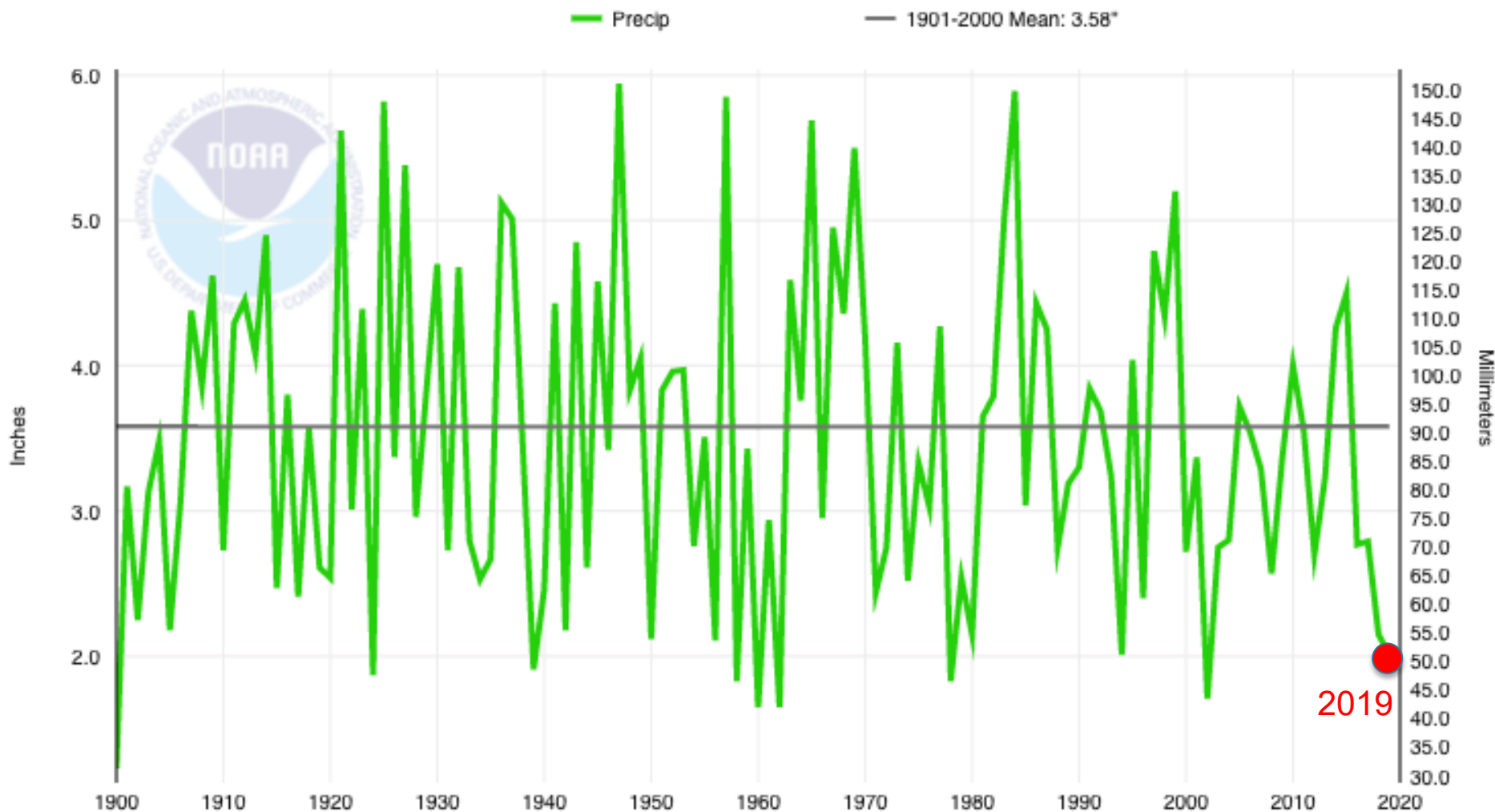


Upper Basin Feb-May precip vs. ENSO state, 1979-2019



Jun-Aug Upper Basin precip: 2019 8th driest

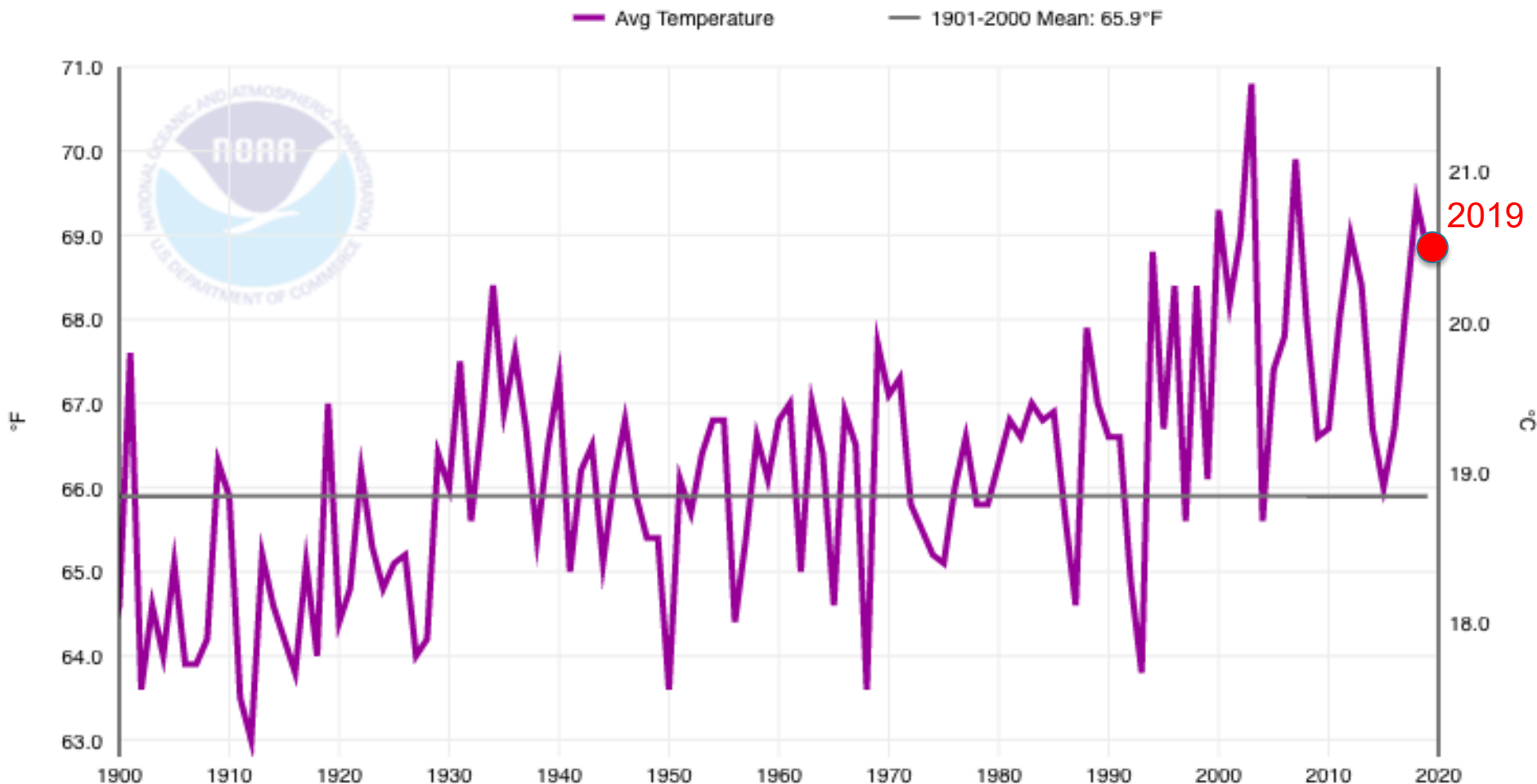
Area-Weighted Upper Colorado River Basin, Precipitation, June-August



Source: NOAA NCEI Climate at a Glance; <https://www.ncdc.noaa.gov/cag/>

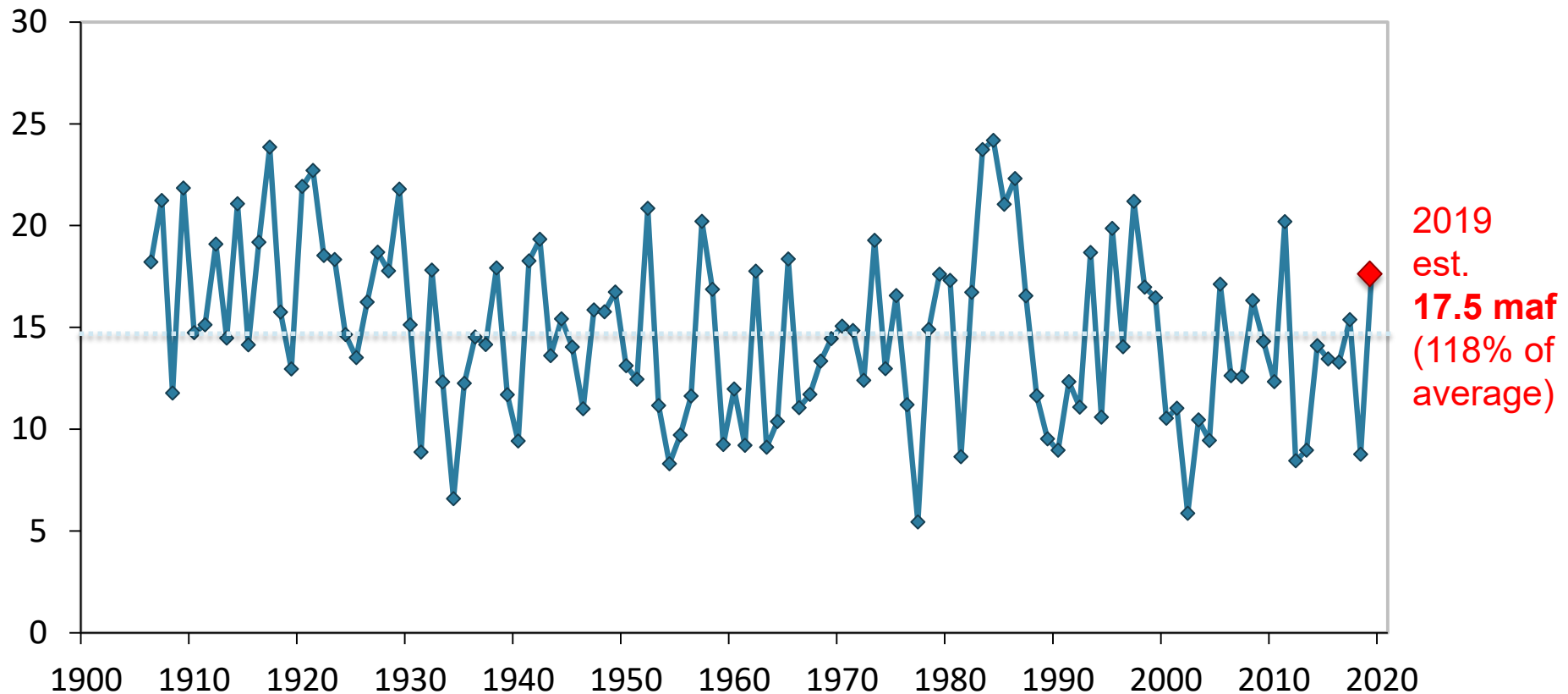
July-Aug Upper Basin temps: 2019 6th warmest

Area-Weighted Upper Colorado River Basin, Average Temperature, July-August

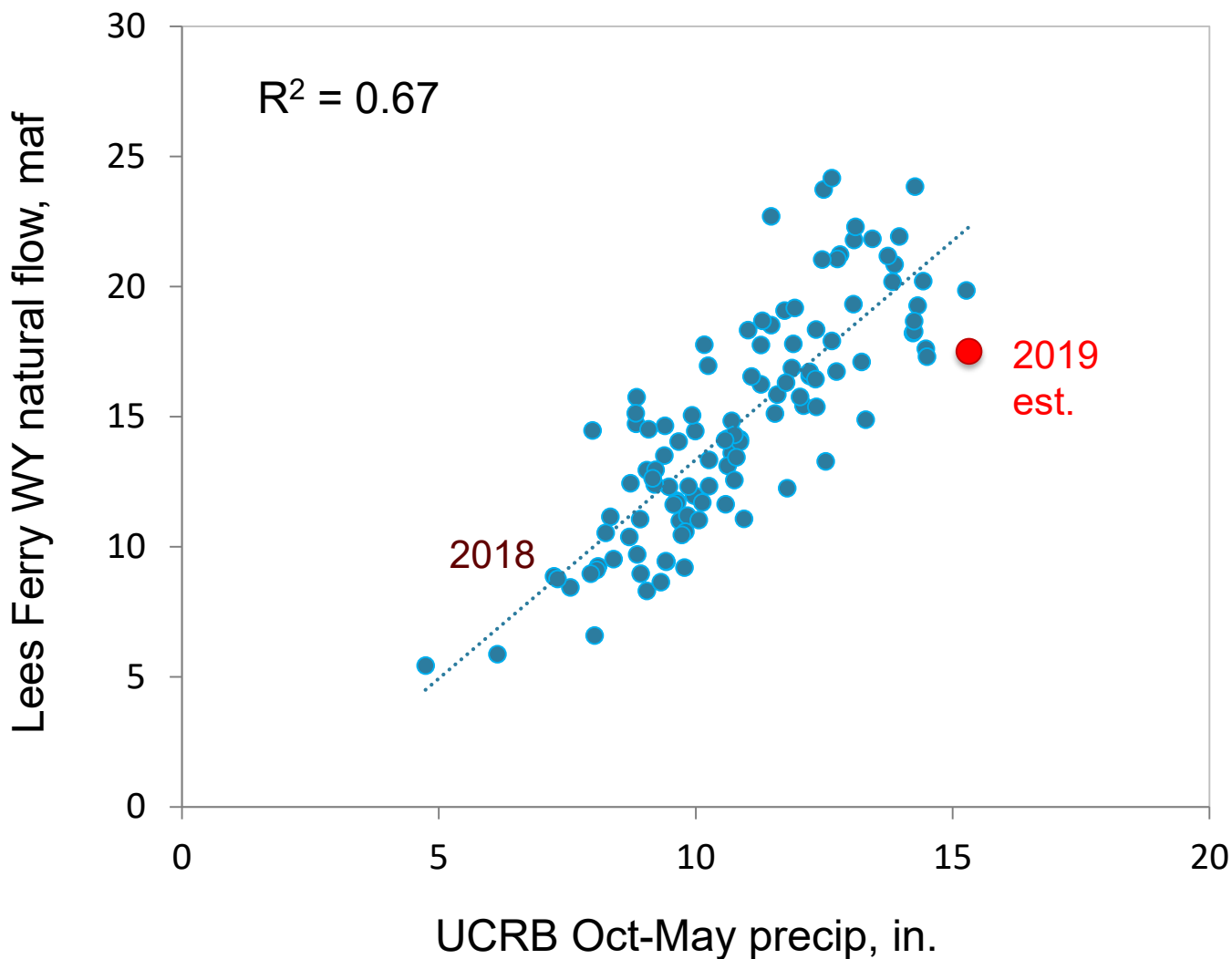


Source: NOAA NCEI Climate at a Glance; <https://www.ncdc.noaa.gov/cag/>

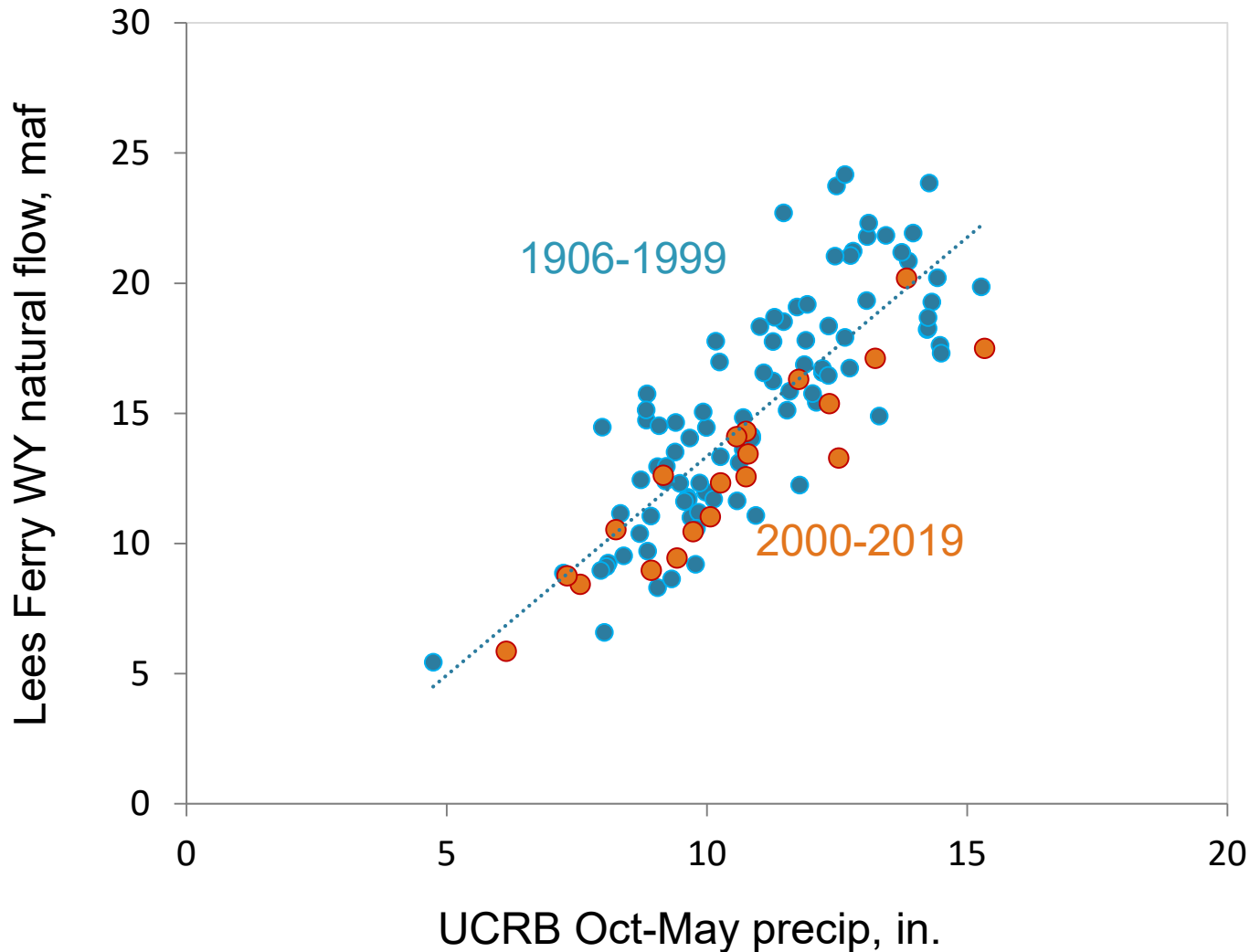
Lees Ferry water-year natural flows: 2019 looking good, but not great



UCRB Oct-May precip vs. Lees Ferry flows, 1900-2019



UCRB Oct-May precip vs. Lees Ferry flows, 1900-2019



Increasing hydroclimatic variability and volatility?

- Upper Basin interannual precipitation variability has increased ~10% since 1980
- Consistent with expectations from climate models: more warming = more precip variability
- Individual storms will tend to be “juicier” in a warmer climate
- And: Warmer summer temperatures will dry out land surface faster

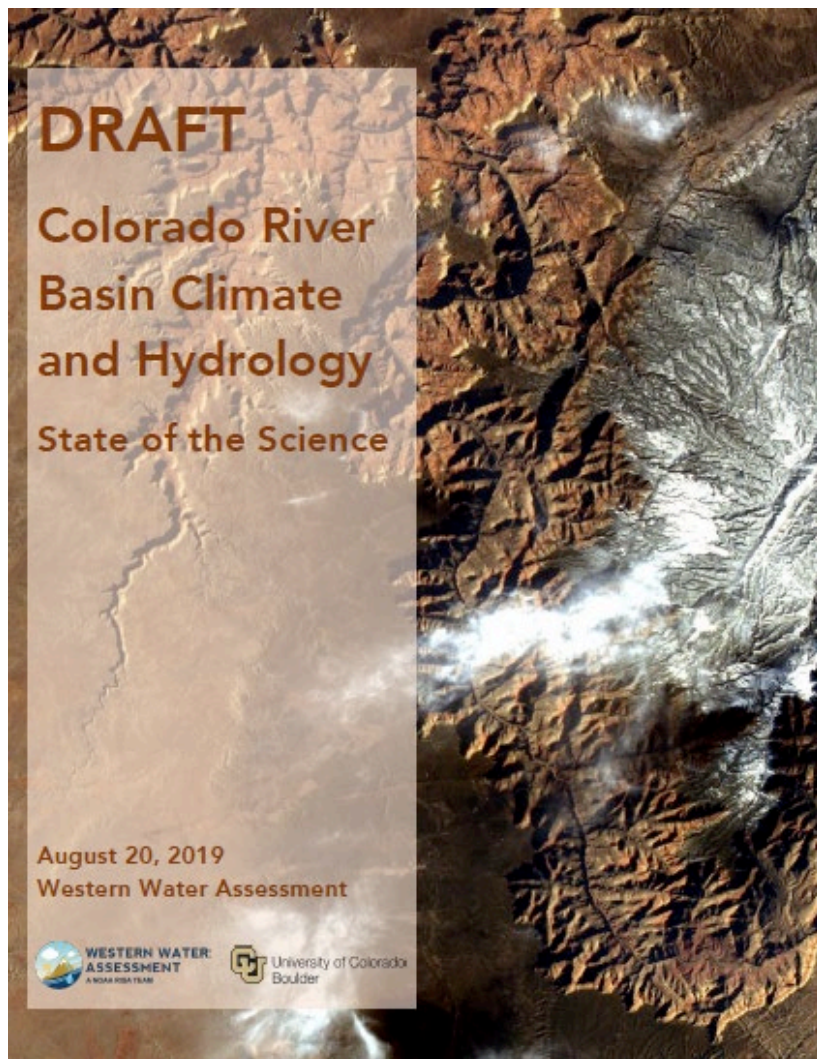
Lessons from Snowpocalypse

- The snowpack and runoff outlook can turn around in a month, given the right weather pattern
- El Niño tilts the odds towards a wet late winter-spring in the Upper Basin, but randomness does the rest
- Extreme seasonal conditions will always be hard to forecast
- There **is** such a thing as too much snow

Lessons from Snowpocalypse

- Near-record precipitation and snowpack does not necessarily translate into near-record annual runoff
- We will likely see more frequent feast-after-famine years (and the reverse)
- As well as more within-season volatility

Colorado River Basin Climate and Hydrology report



Volume I. Background

- **Introduction**
- **Current understanding of basin hydroclimate**
- **Primary operations and planning tools**

Volume II. Informing all time scales

- **Observations – Weather and climate**
- **Observations – Hydrology**
- **Hydrologic models**

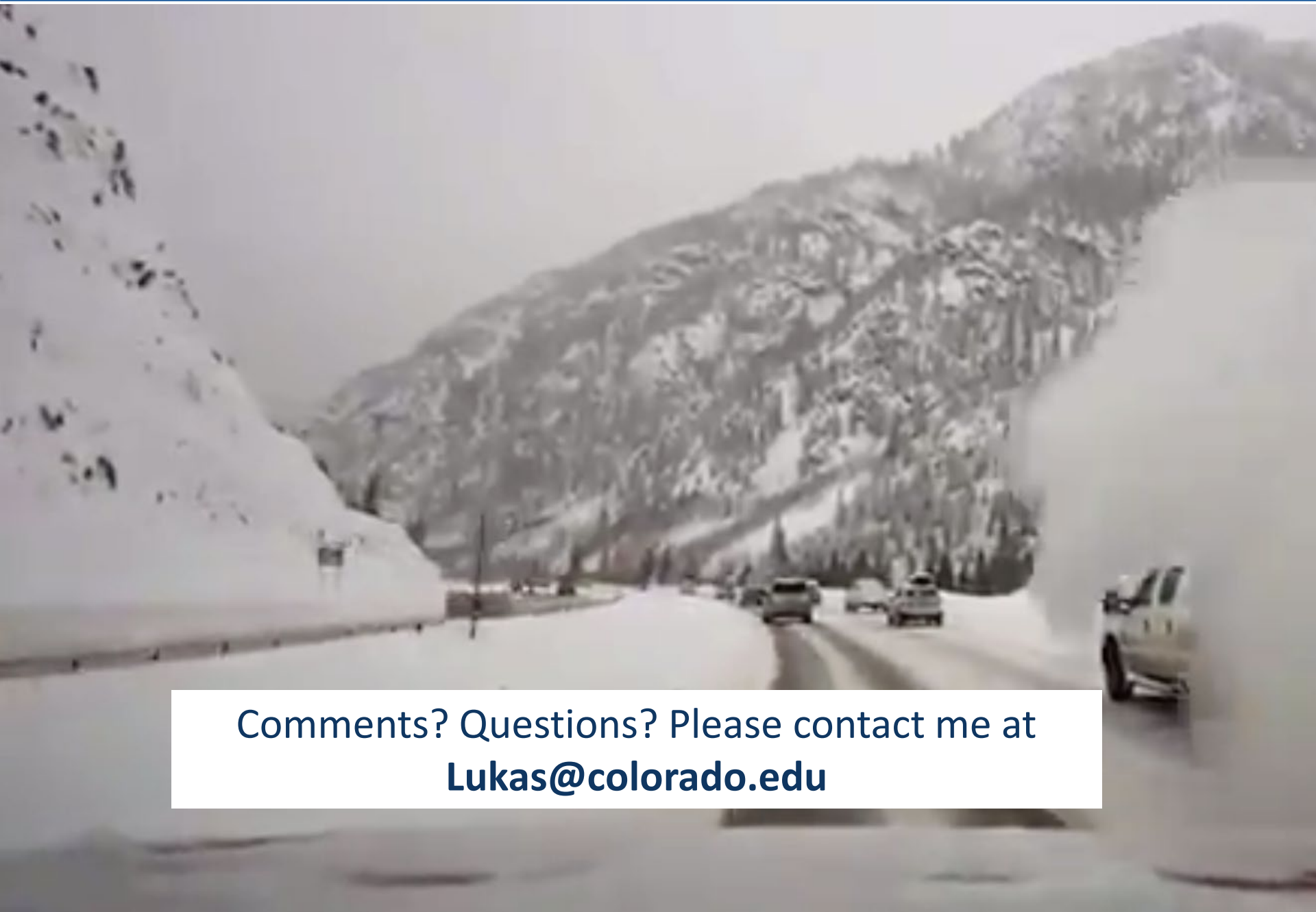
Volume III. Short-term and mid-term

- **Weather and climate forecasting**
- **Streamflow forecasting**

Volume IV. Long-term

- **Historical hydrology**
- **Paleohydrology**
- **Climate-change-informed hydrology**

*Scheduled release: **December 2019***



Comments? Questions? Please contact me at
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