



Colorado Climate Update and Outlook!

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Colorado Climate Center
Colorado State University

With much appreciated help from Zach Schwalbe

Arkansas River Basin Water Forum
Salida, Colorado April 28, 2016

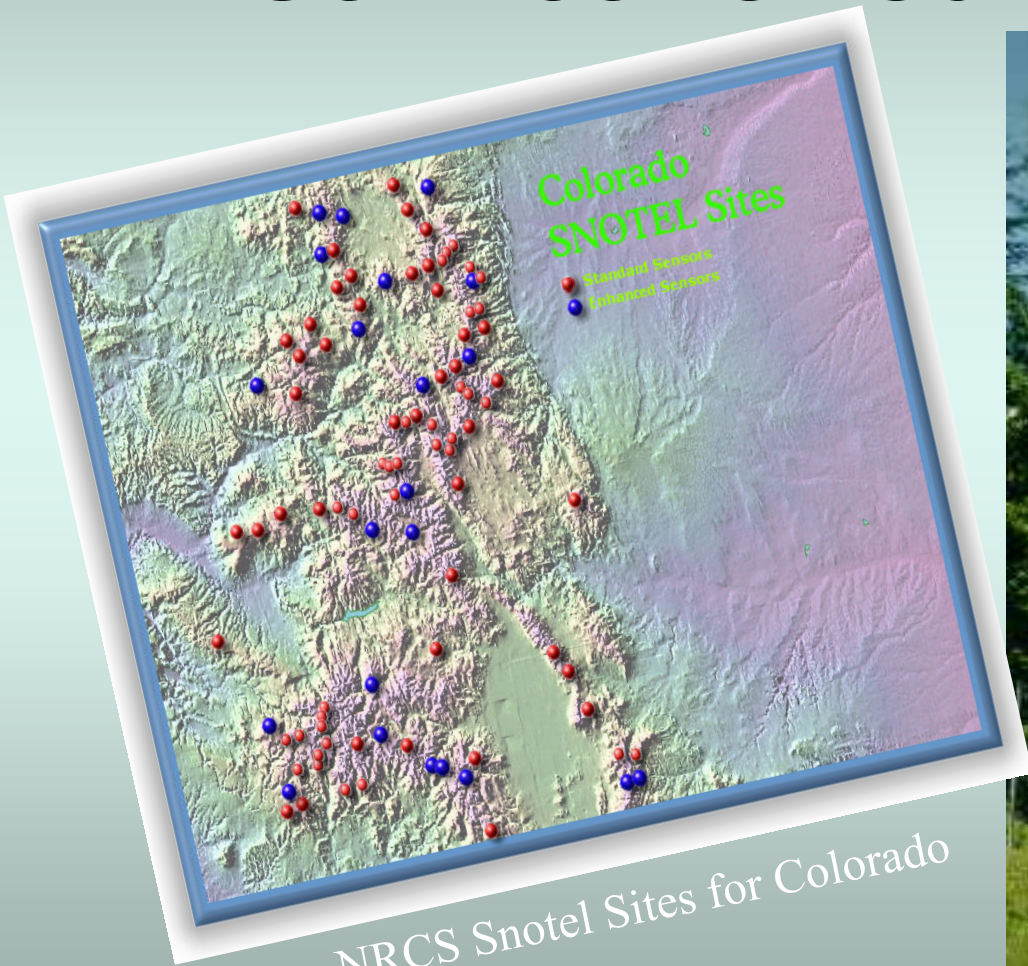
Topics we will cover today

- Data appreciation
- Climate Status update
- What comes next



Thanks to the National Weather Service for faithfully maintaining a “taken for granted” network of weather stations in Colorado and across the country – the Cooperative Observer Network

Thanks to the USDA Natural Resources Conservation Service for our snow data



NRCS Snotel Sites for Colorado



Typical NRCS Snotel Site

Backyard Rain Gauge Party

The Community Collaborative Rain, Hail and Snow Network -- CoCoRaHS



THANKS to you who
measure or provide
support



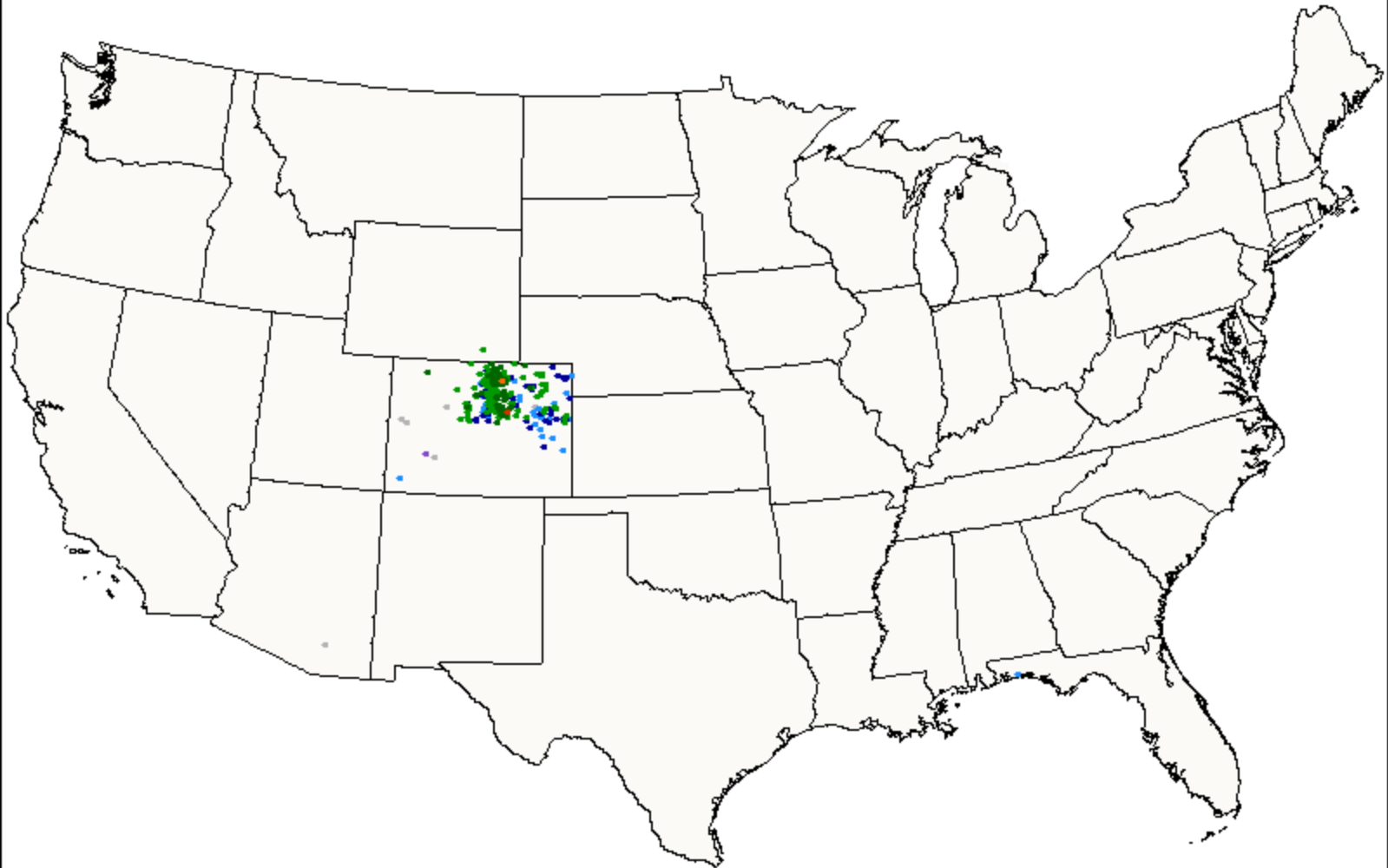
Photos by H. Reges

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

USA 4/24/2003

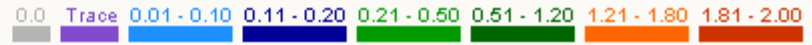
0.0 Trace 0.01 - 0.25 0.26 - 0.50 0.51 - 1.24 1.25 - 2.97 2.98 - 4.45 4.46 - 4.94

CoCoRaHS rain gauge reports April 24, 2003

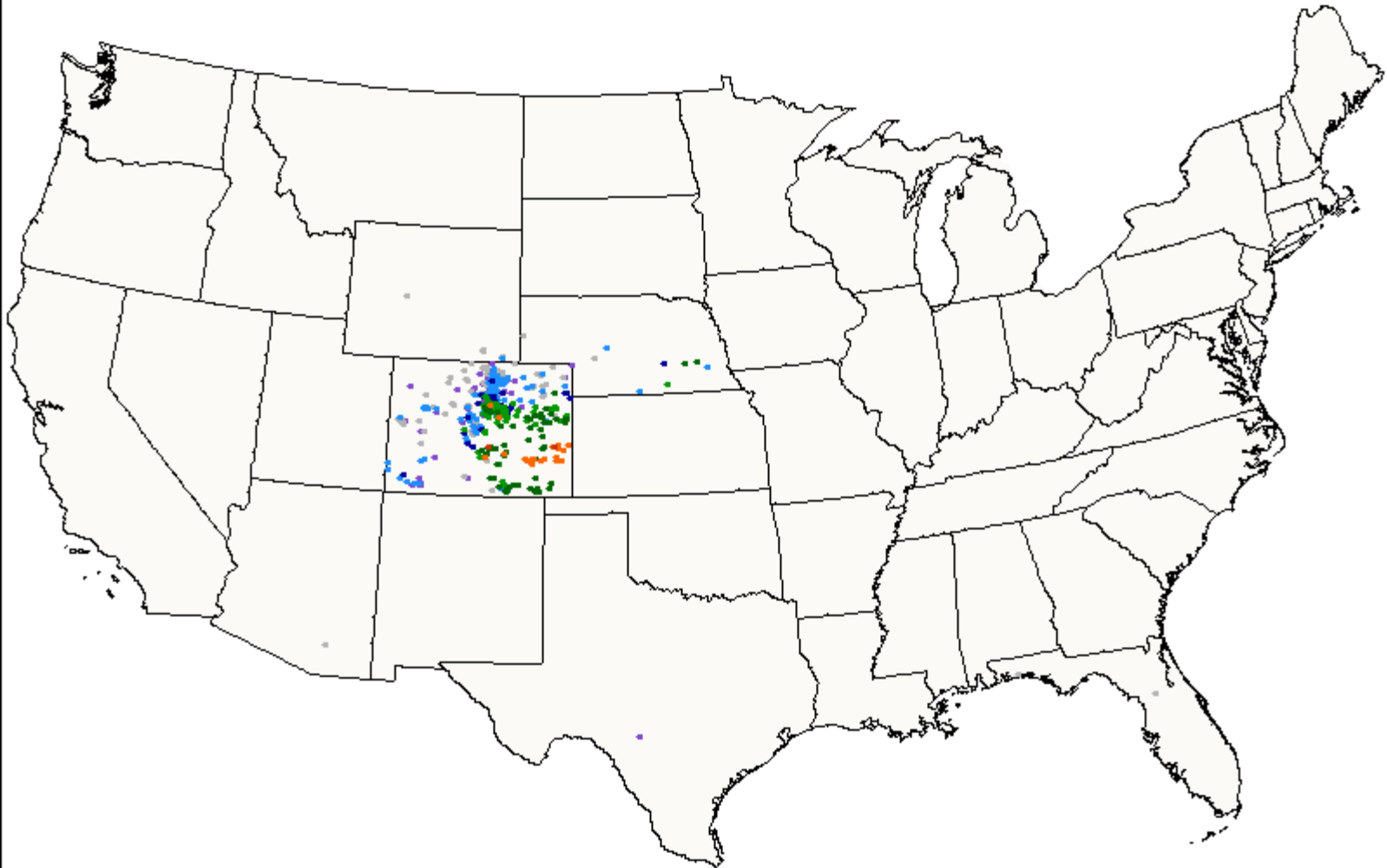


Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

USA 4/24/2004



CoCoRaHS rain gauge reports April 24, 2004



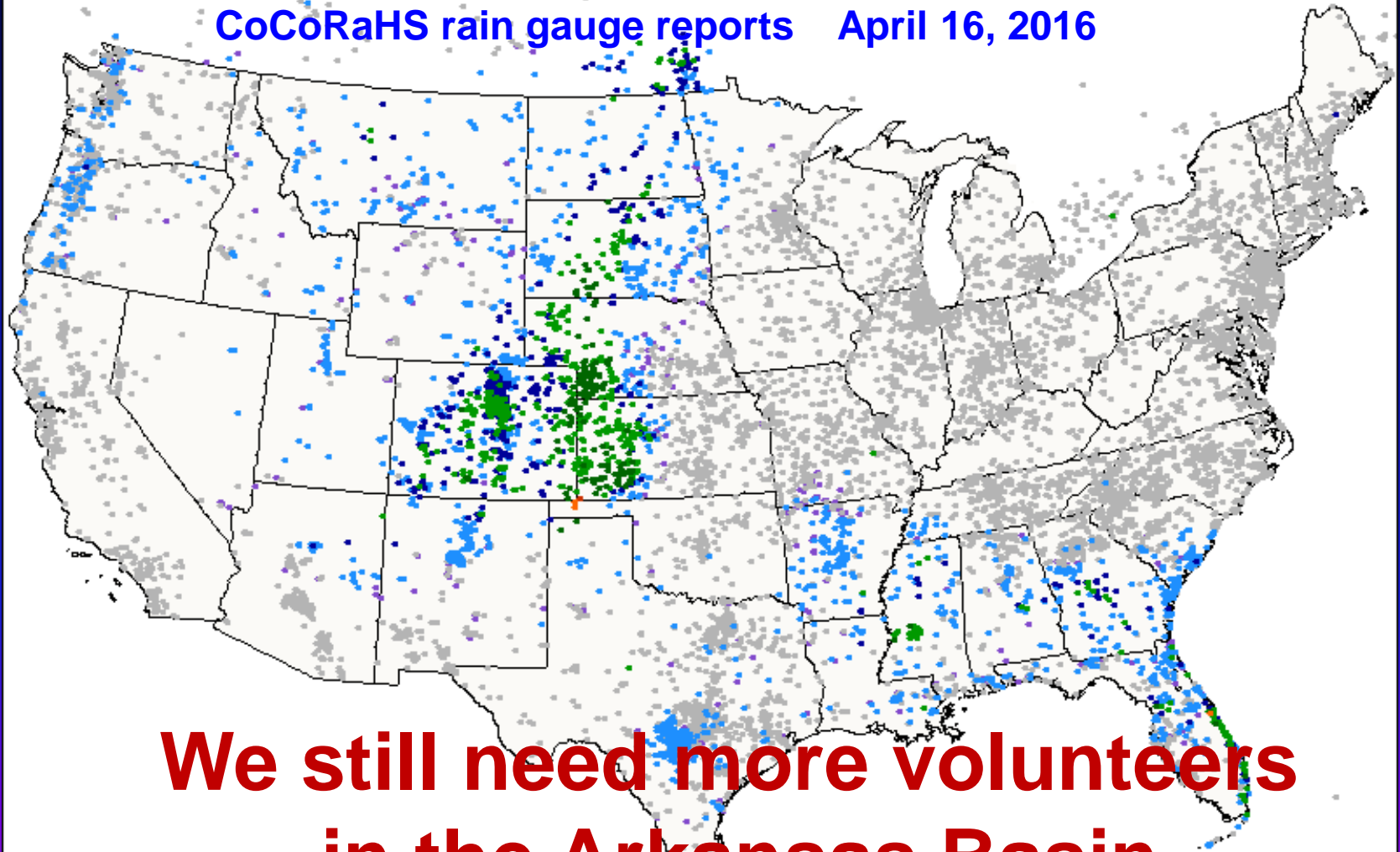
Thanks to Bob A. and Jane W.

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am

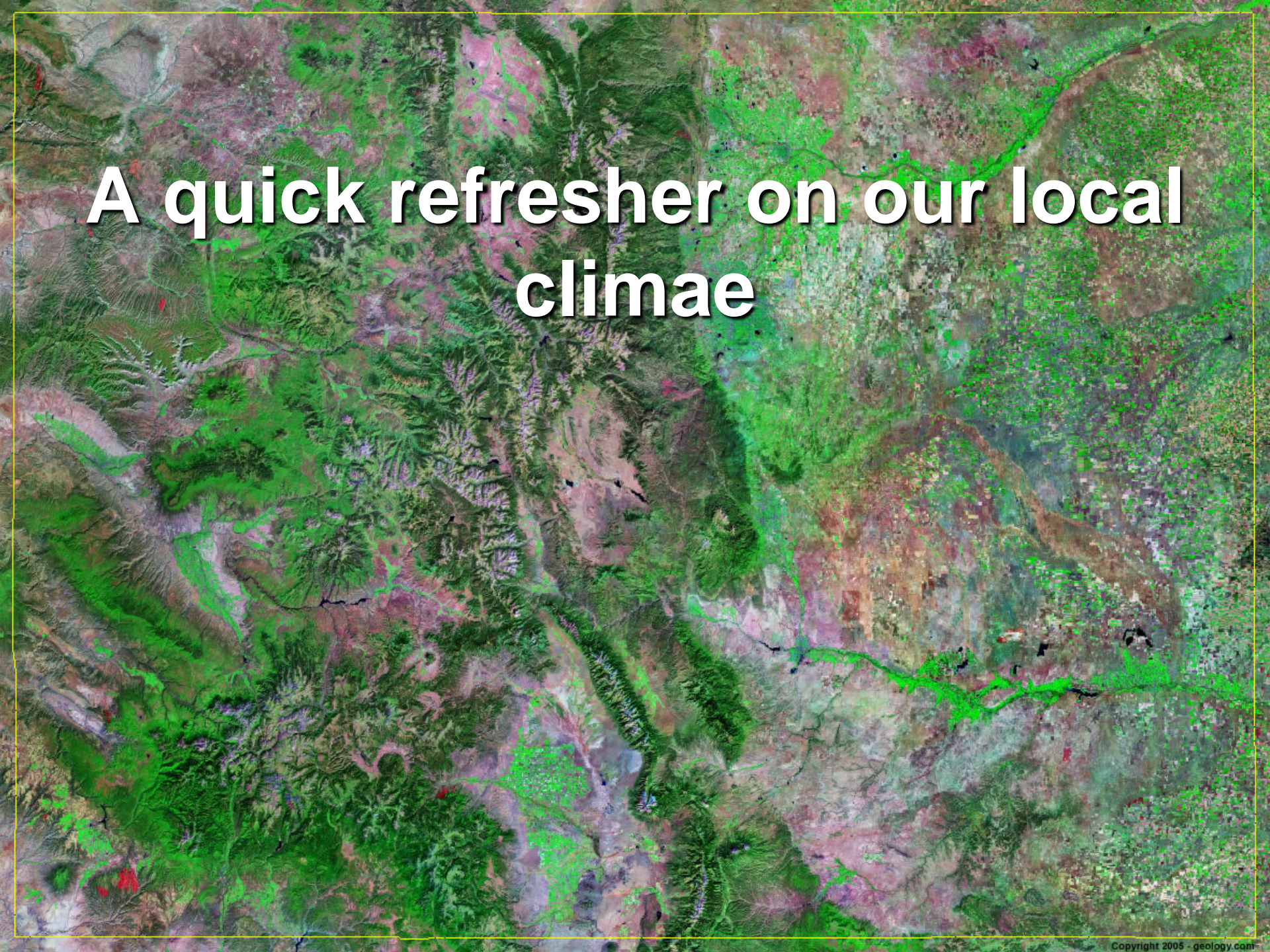
USA 4/16/2016

0.0 Trace 0.01 - 0.33 0.34 - 0.66 0.67 - 1.64 1.65 - 3.92 3.93 - 5.88 5.89 - 6.52

CoCoRaHS rain gauge reports April 16, 2016

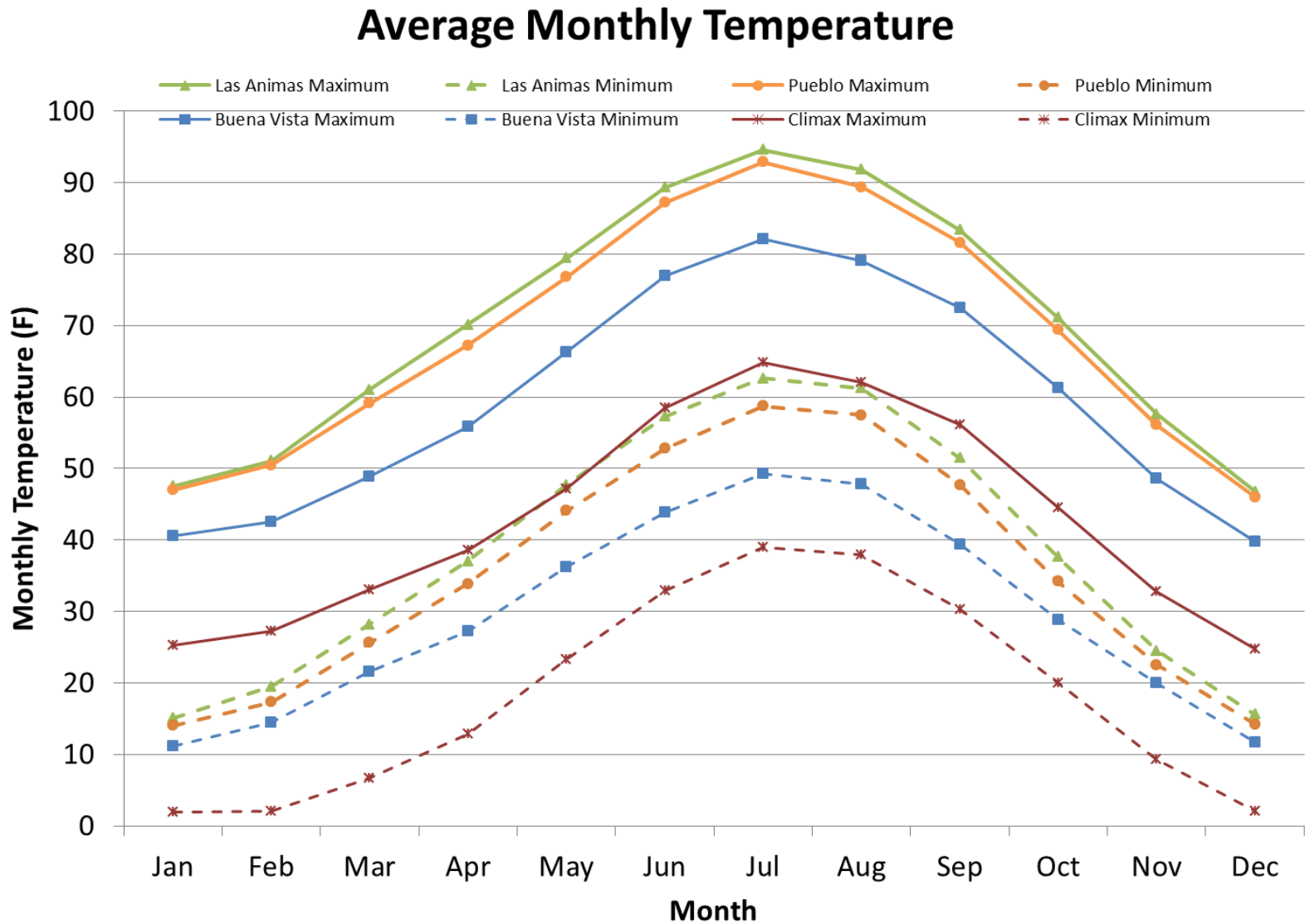


**We still need more volunteers
in the Arkansas Basin**

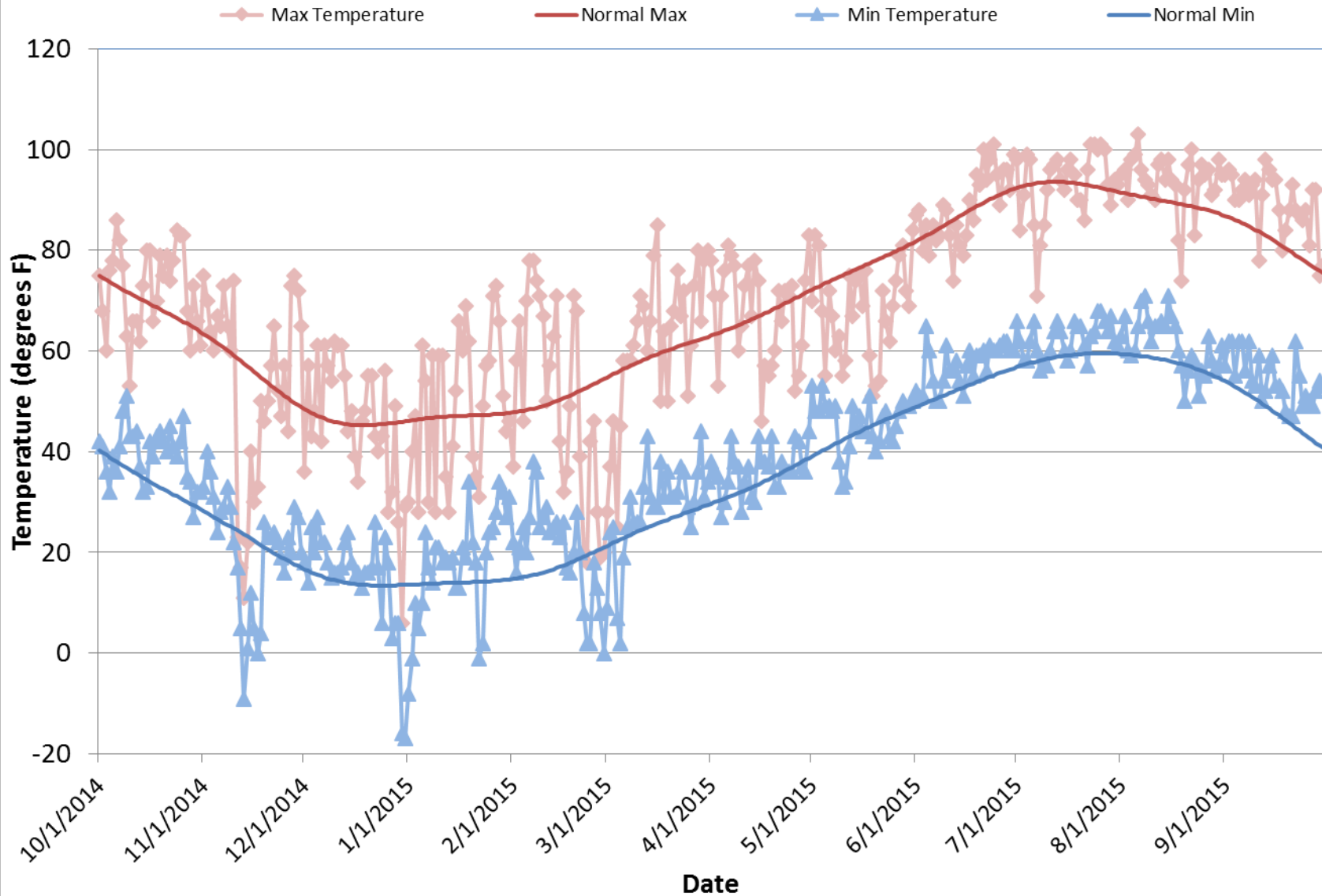


A quick refresher on our local climae

Average Temperatures in the Arkansas River Basin

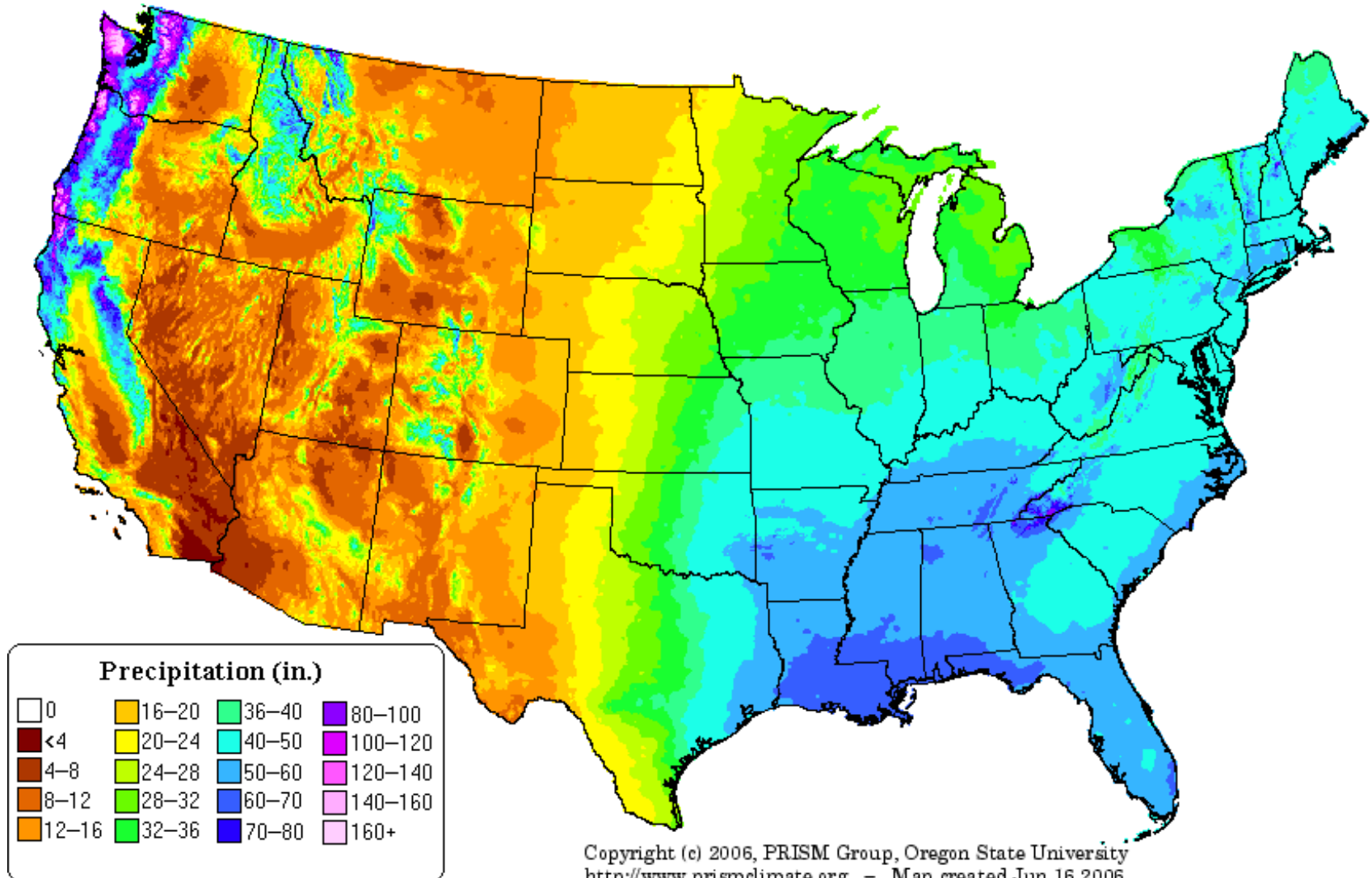


Pueblo Airport Daily Max/Min Temperatures and Normal for Water Year 2015

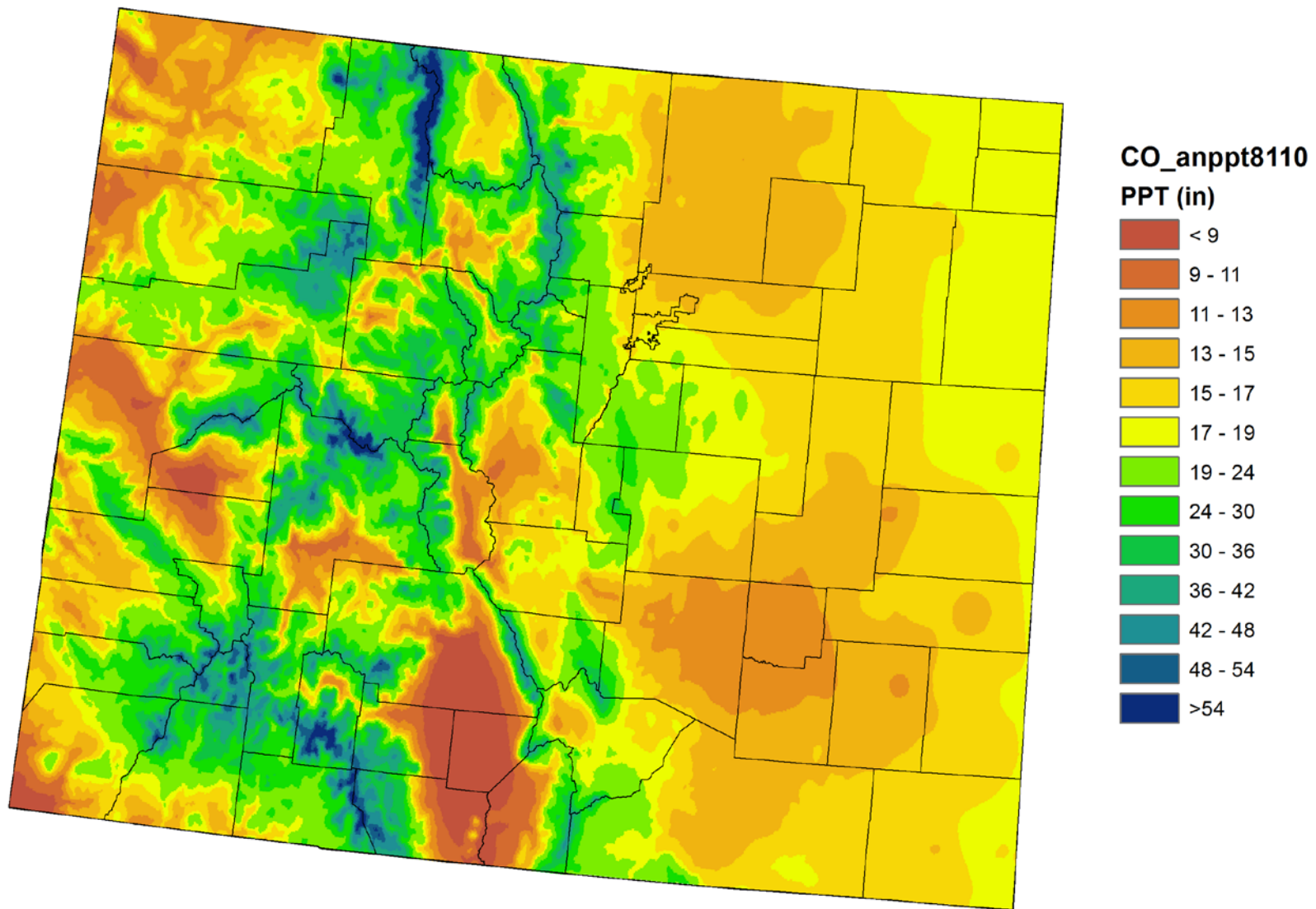


Where we fit in the national picture

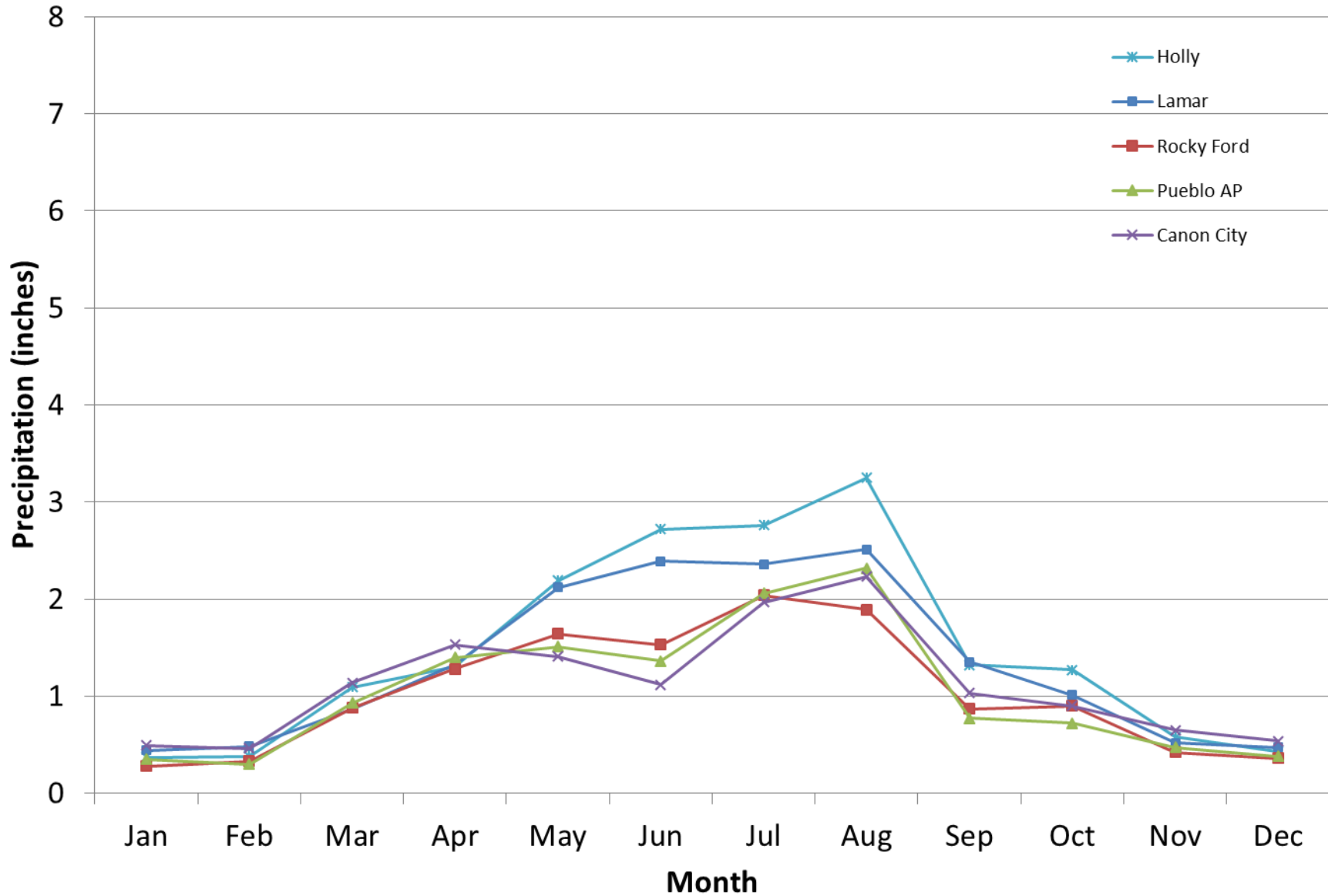
Precipitation: Annual Climatology (1971–2000)



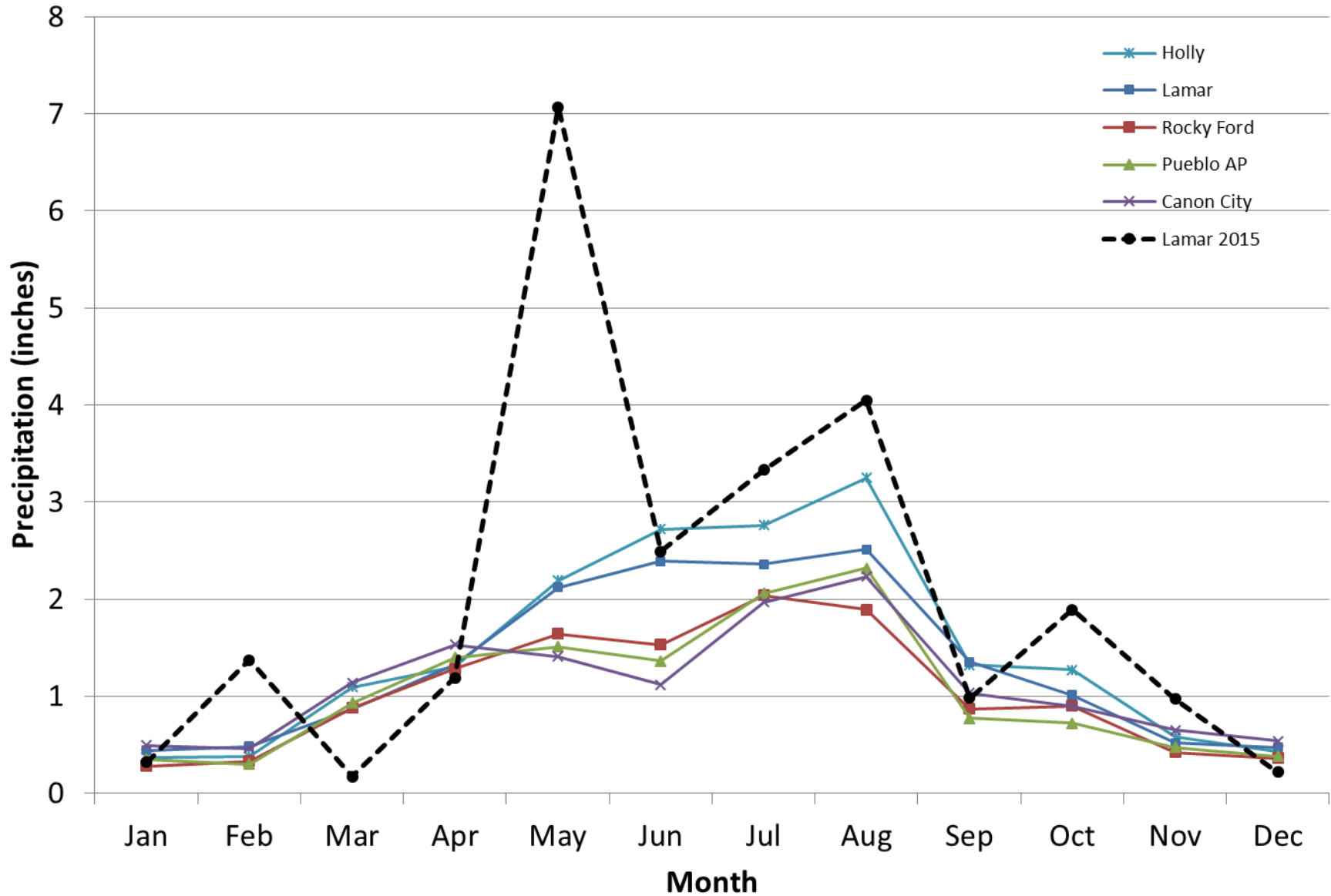
Colorado Annual Average Precipitation (in) 1981-2010



Average Monthly Precipitation



Average Monthly Precipitation

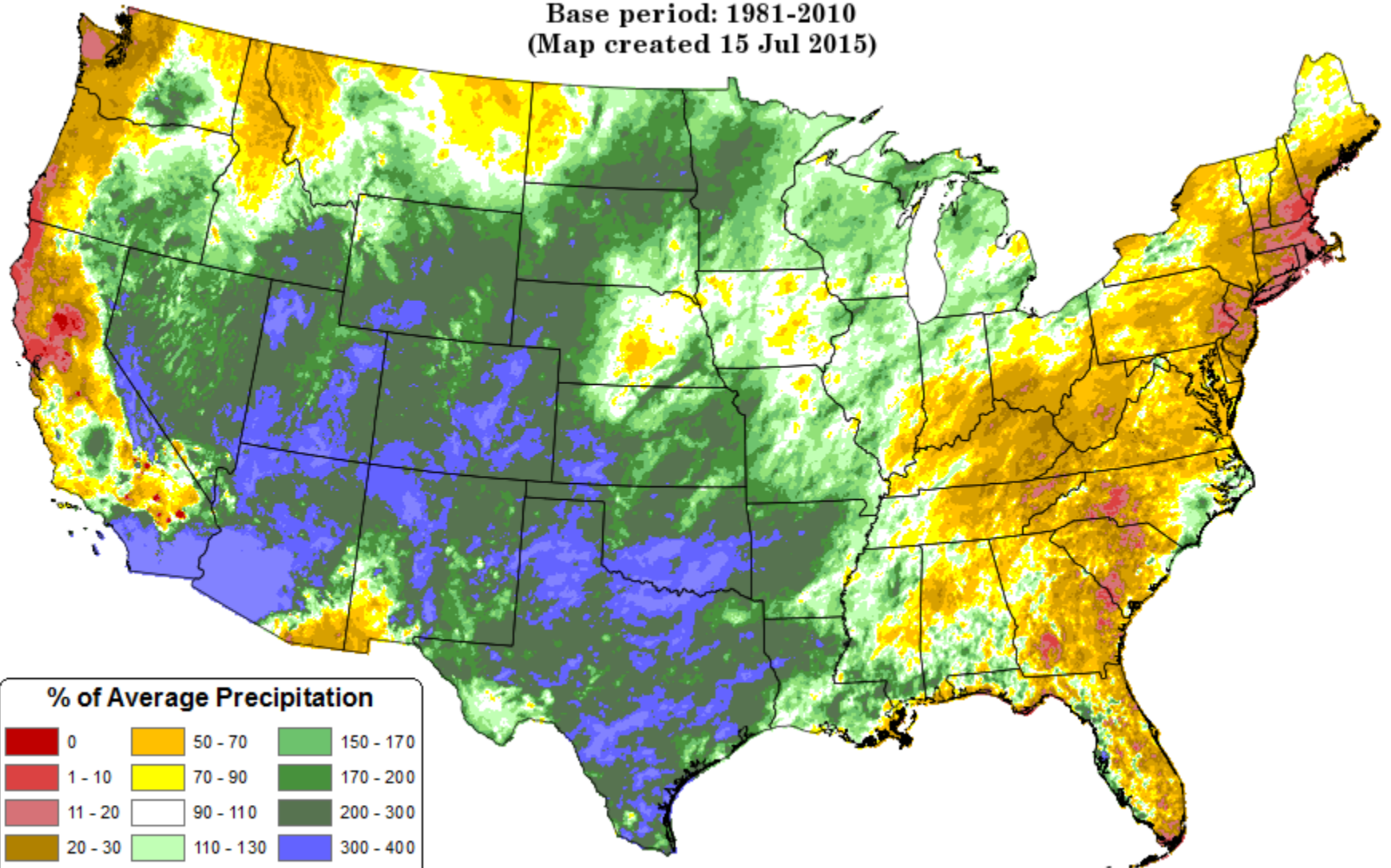


Total Precipitation Anomaly: May 2015

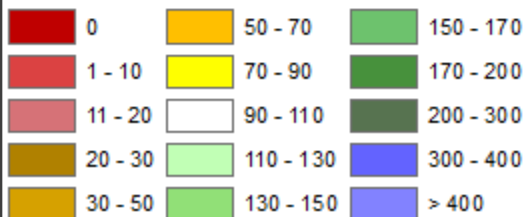
Period ending 31 May 2015

Base period: 1981-2010

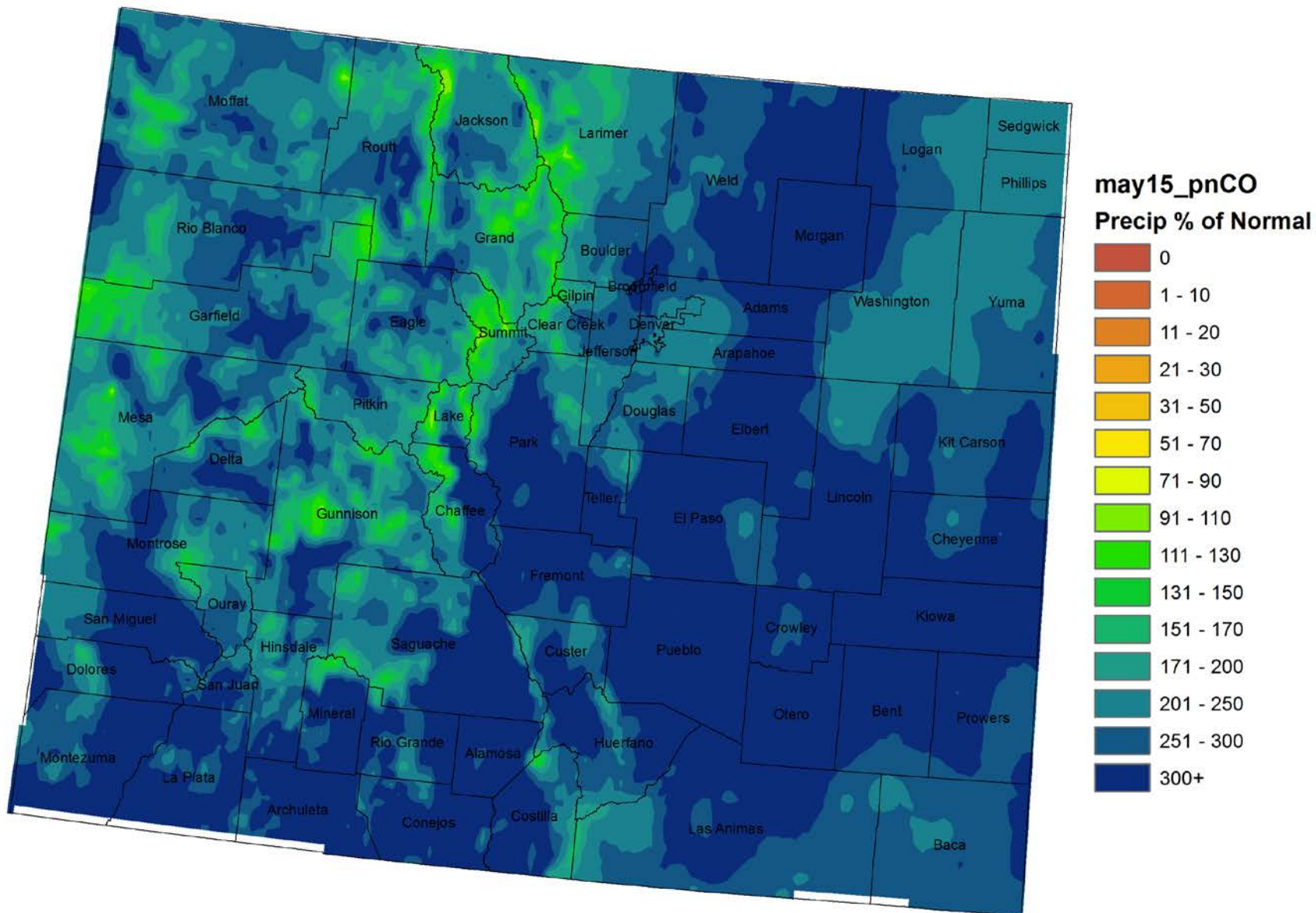
(Map created 15 Jul 2015)



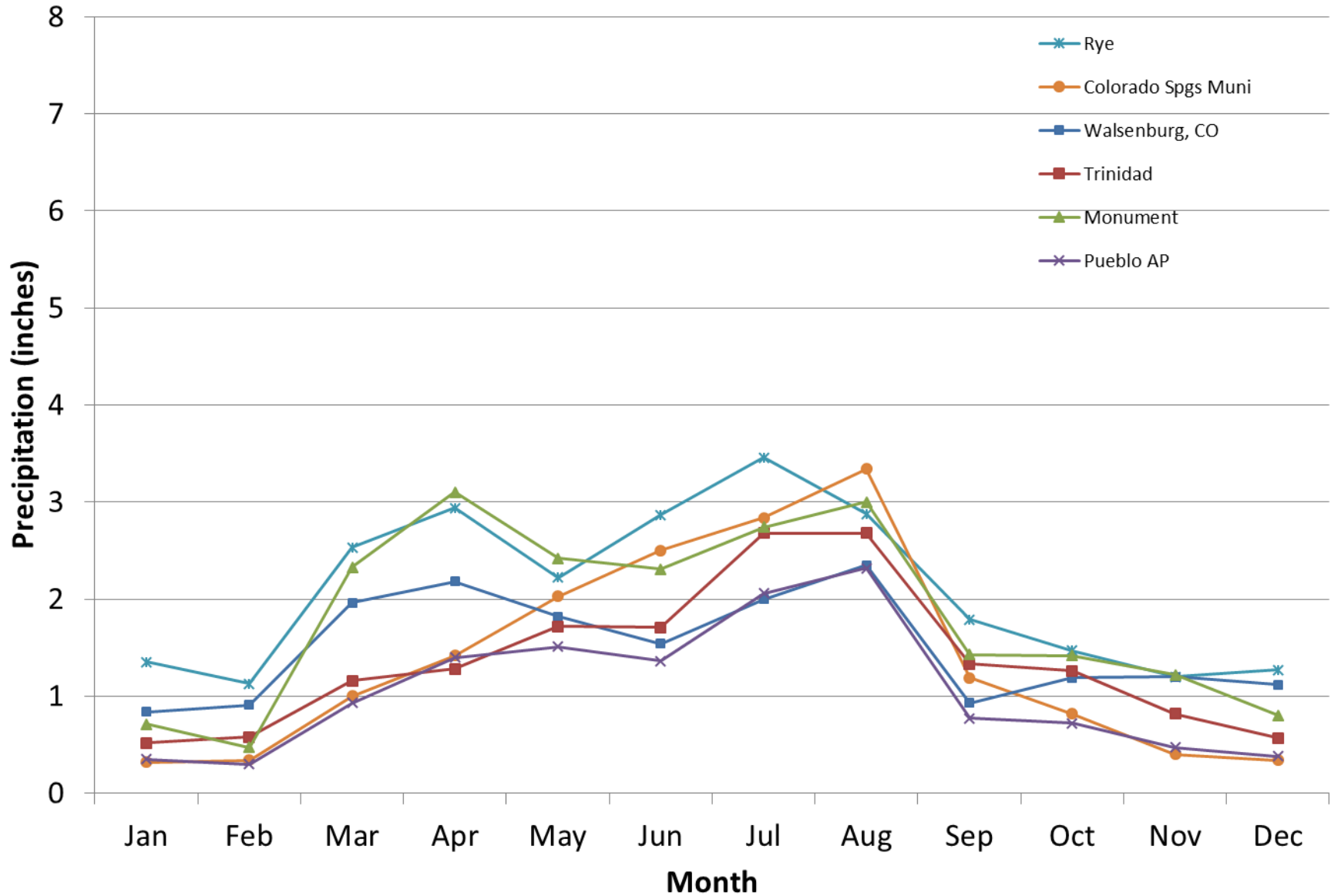
% of Average Precipitation



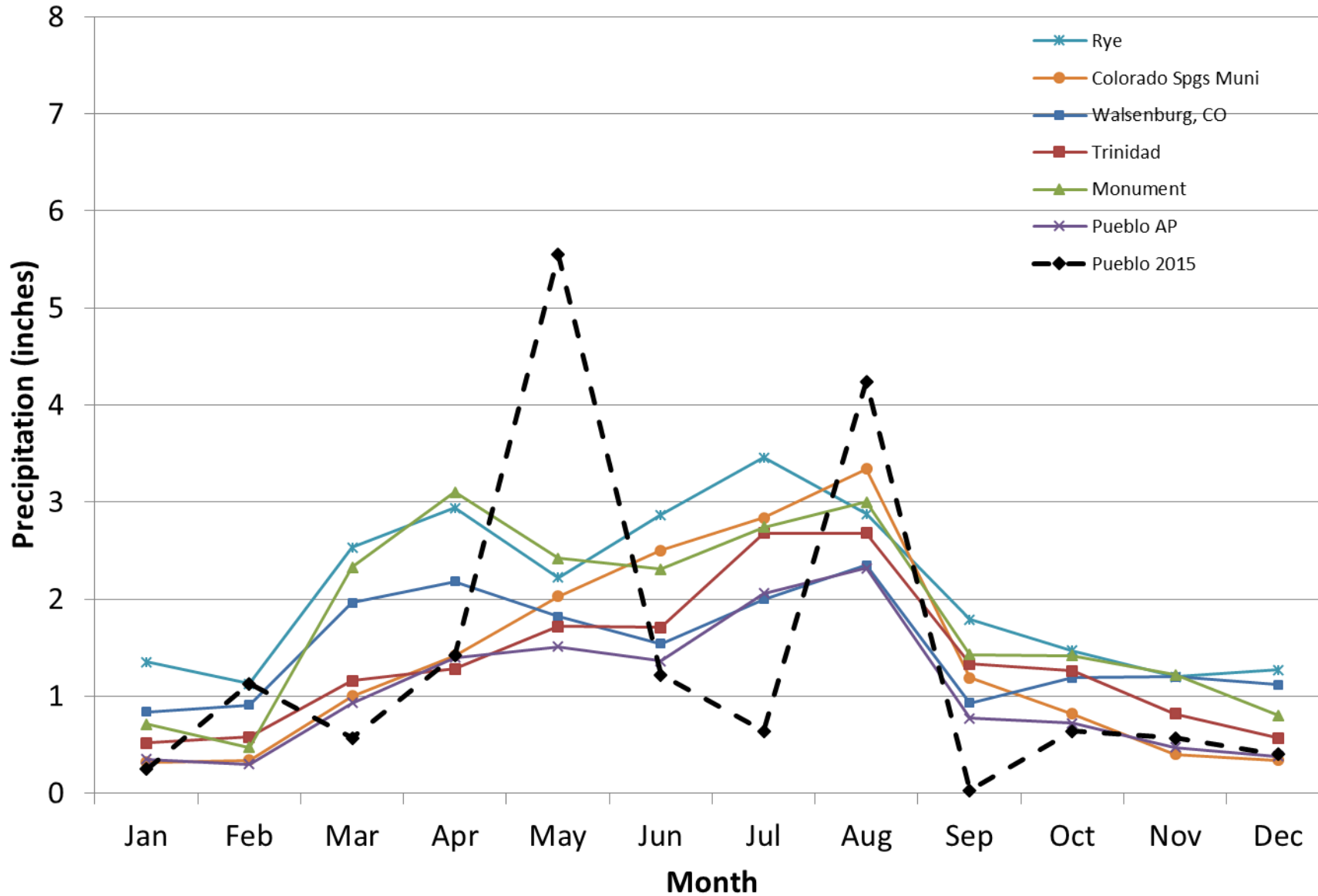
Colorado May 2015 Precipitation as a Percentage of Normal



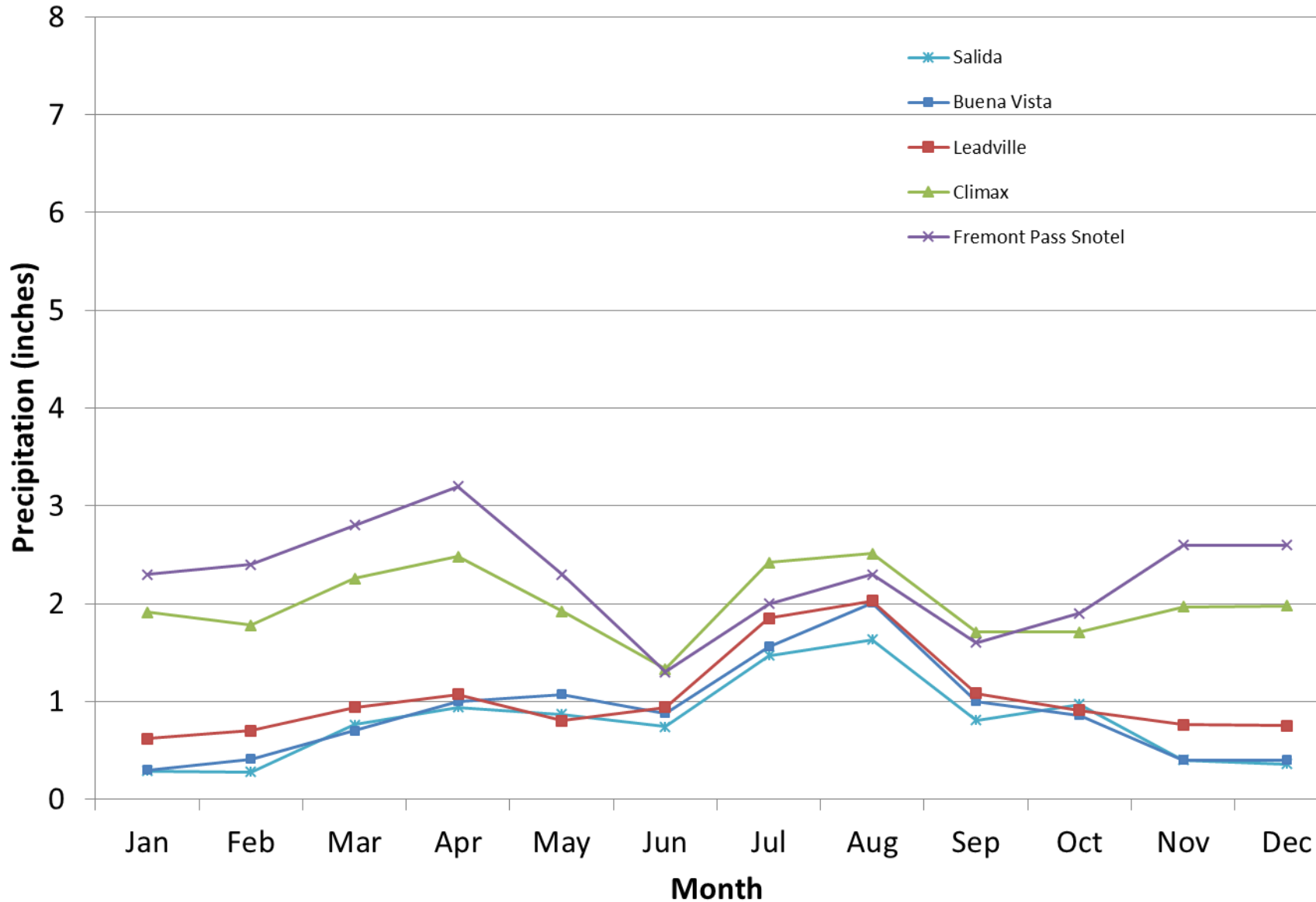
Average Monthly Precipitation



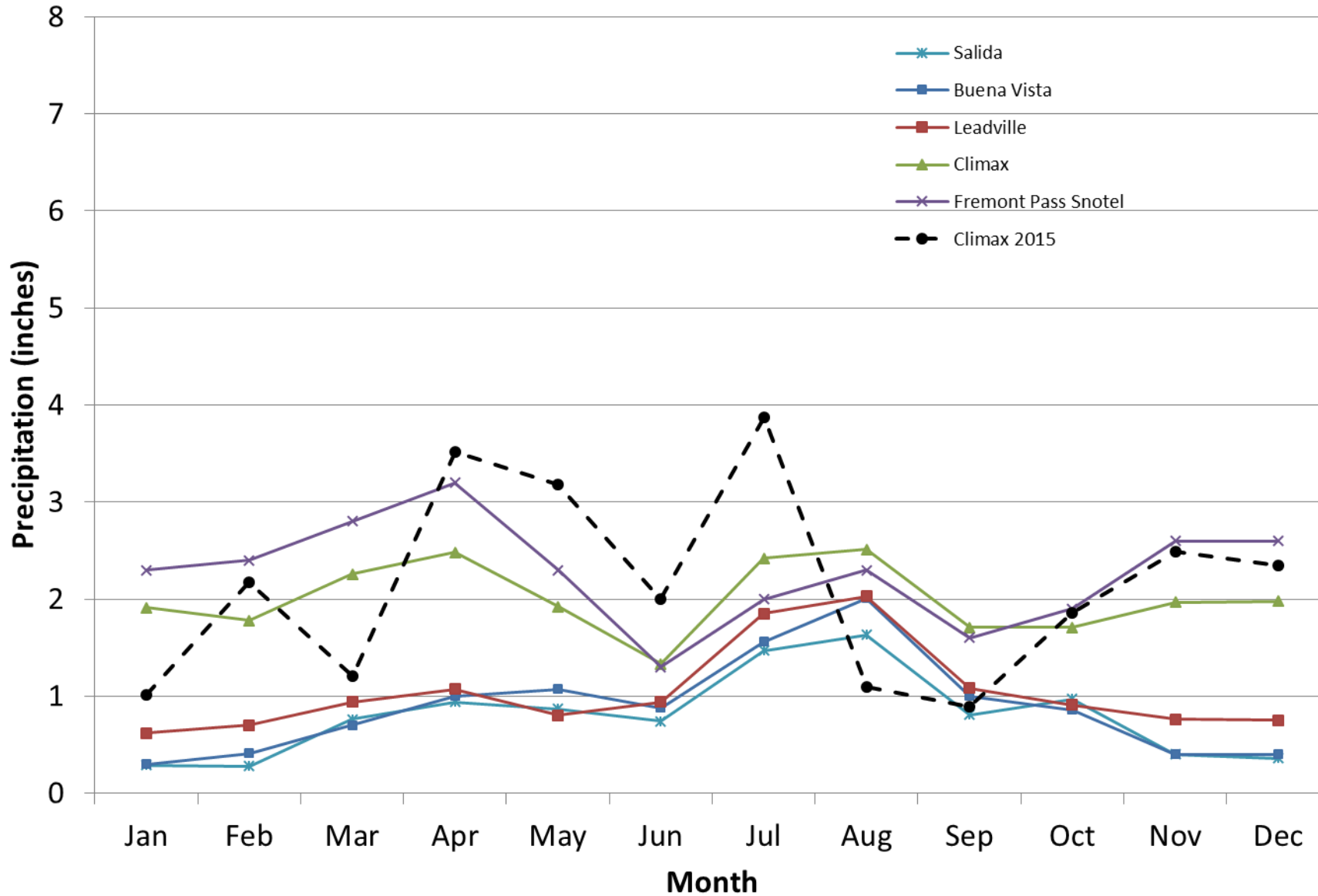
Average Monthly Precipitation



Average Monthly Precipitation



Average Monthly Precipitation

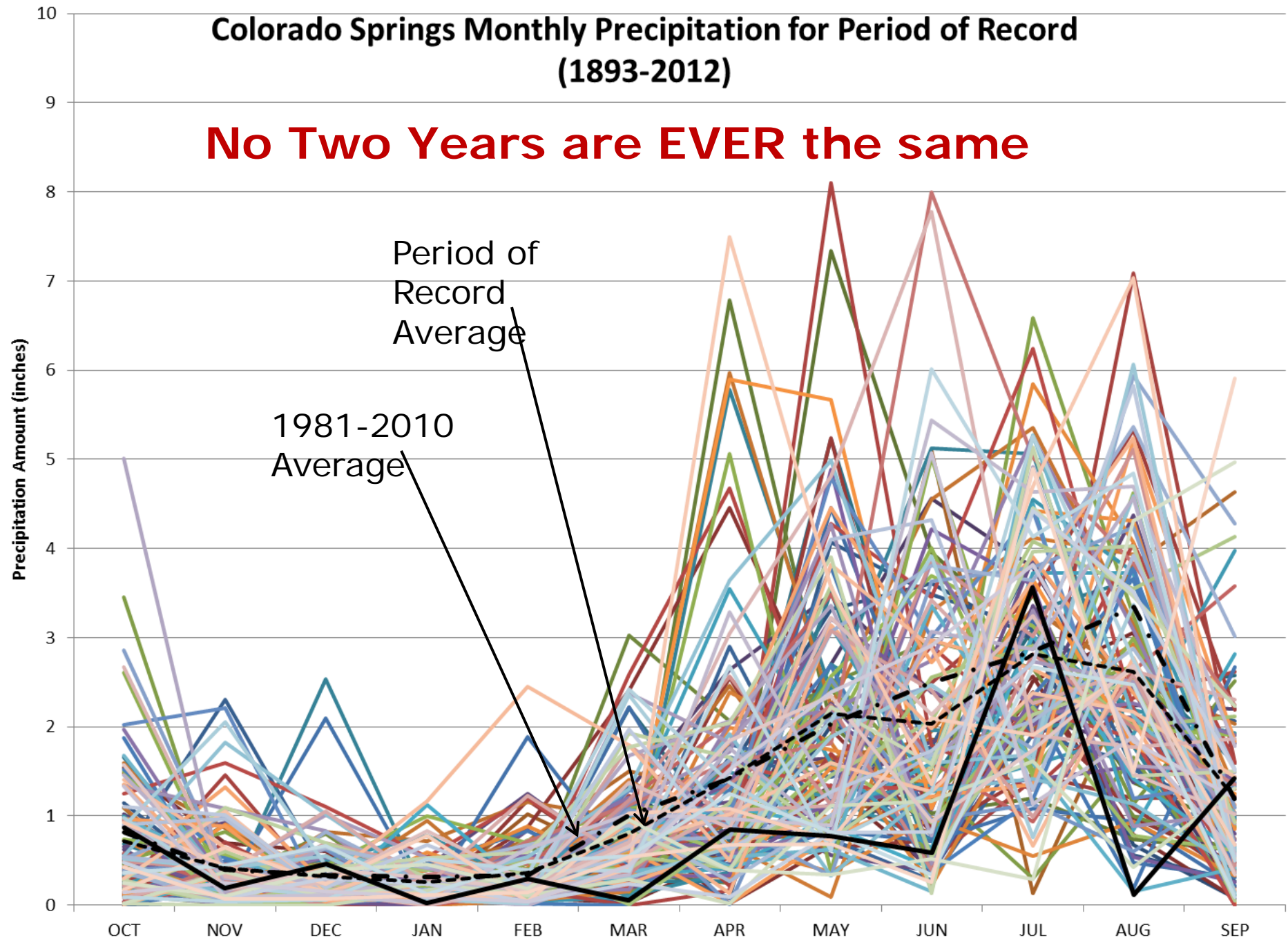


Year-to-Year Variations in Precipitation are crazy big



Colorado Springs Monthly Precipitation for Period of Record (1893-2012)

No Two Years are EVER the same

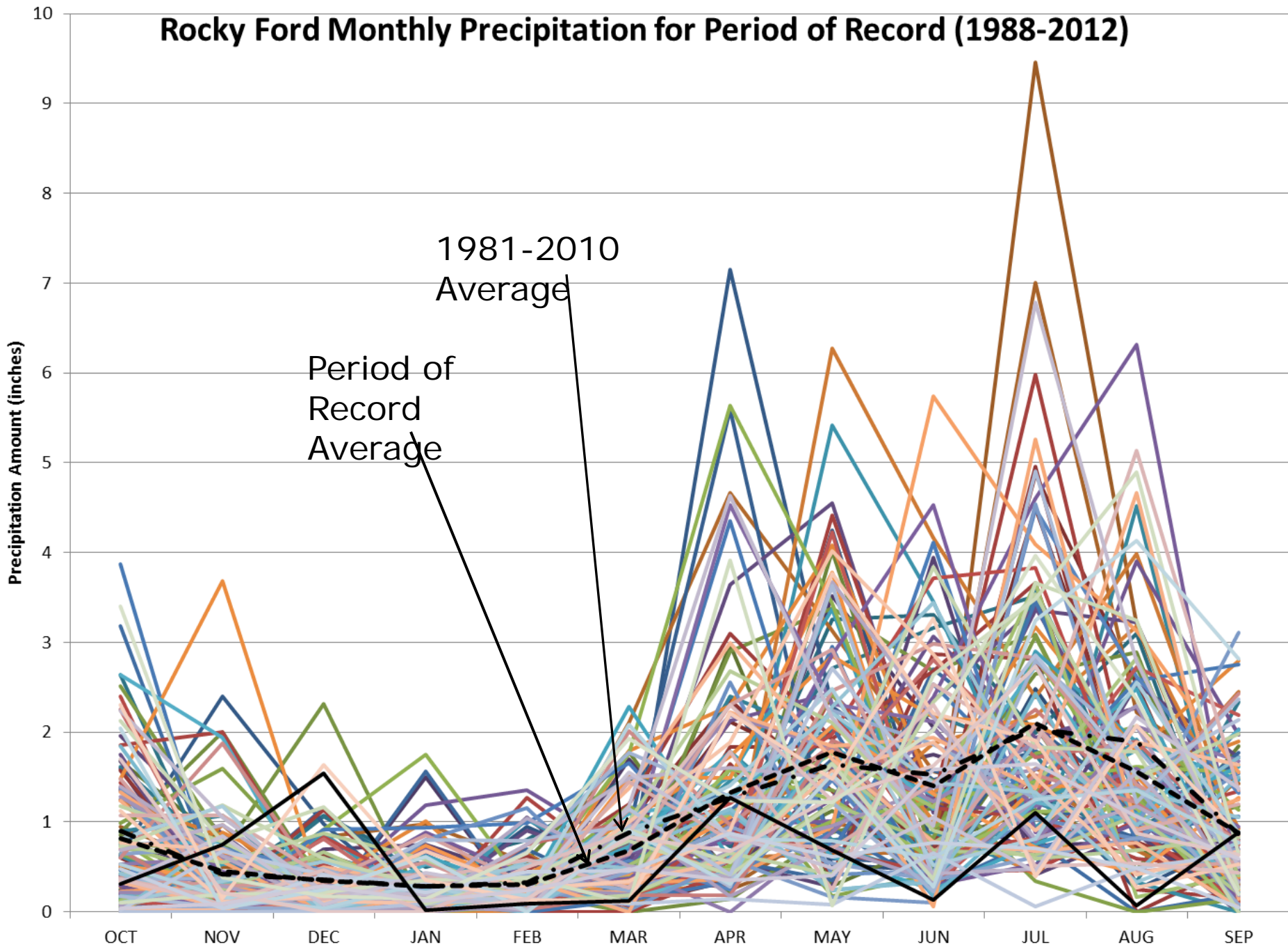


Period of Record Average

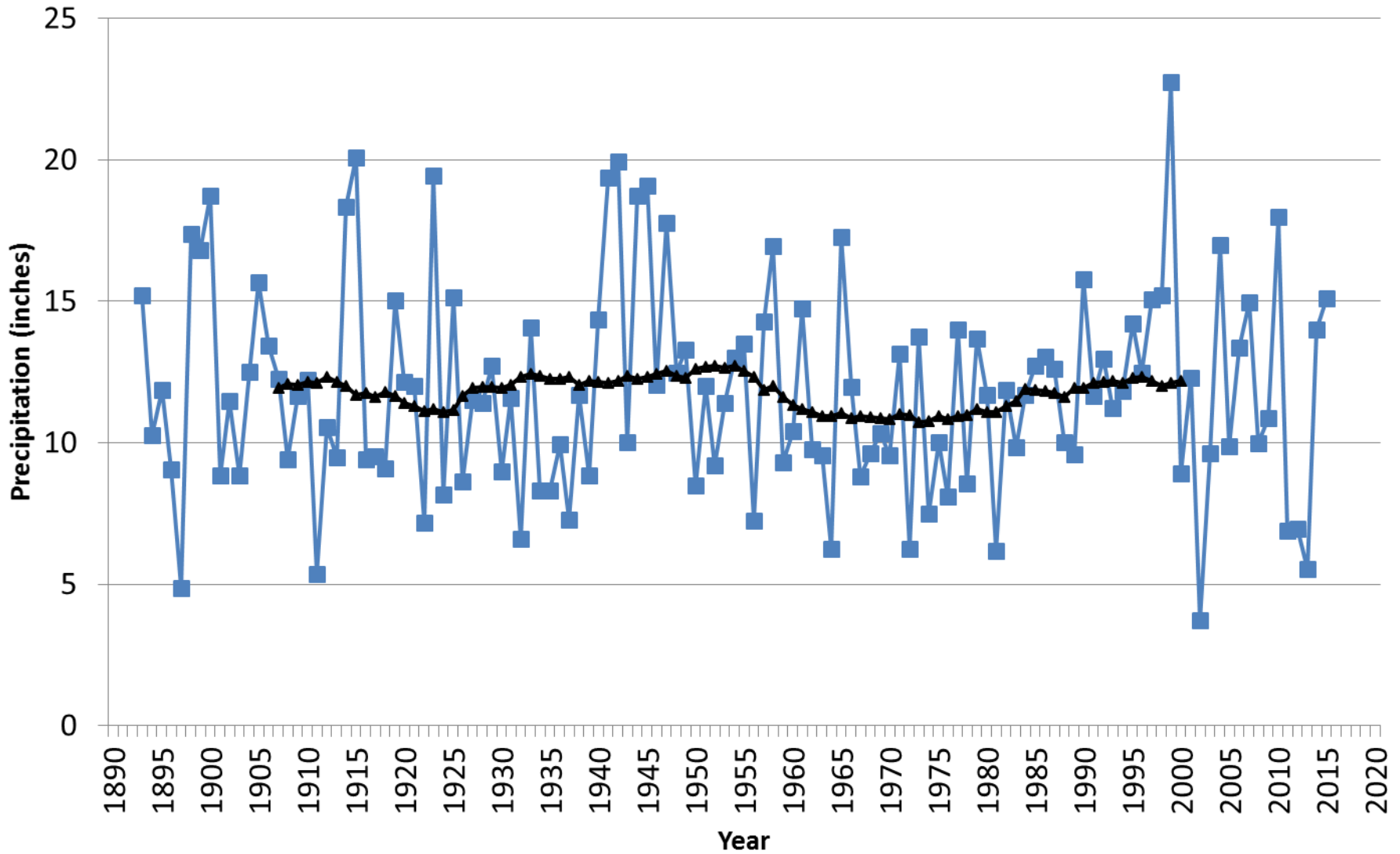
1981-2010 Average

OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP

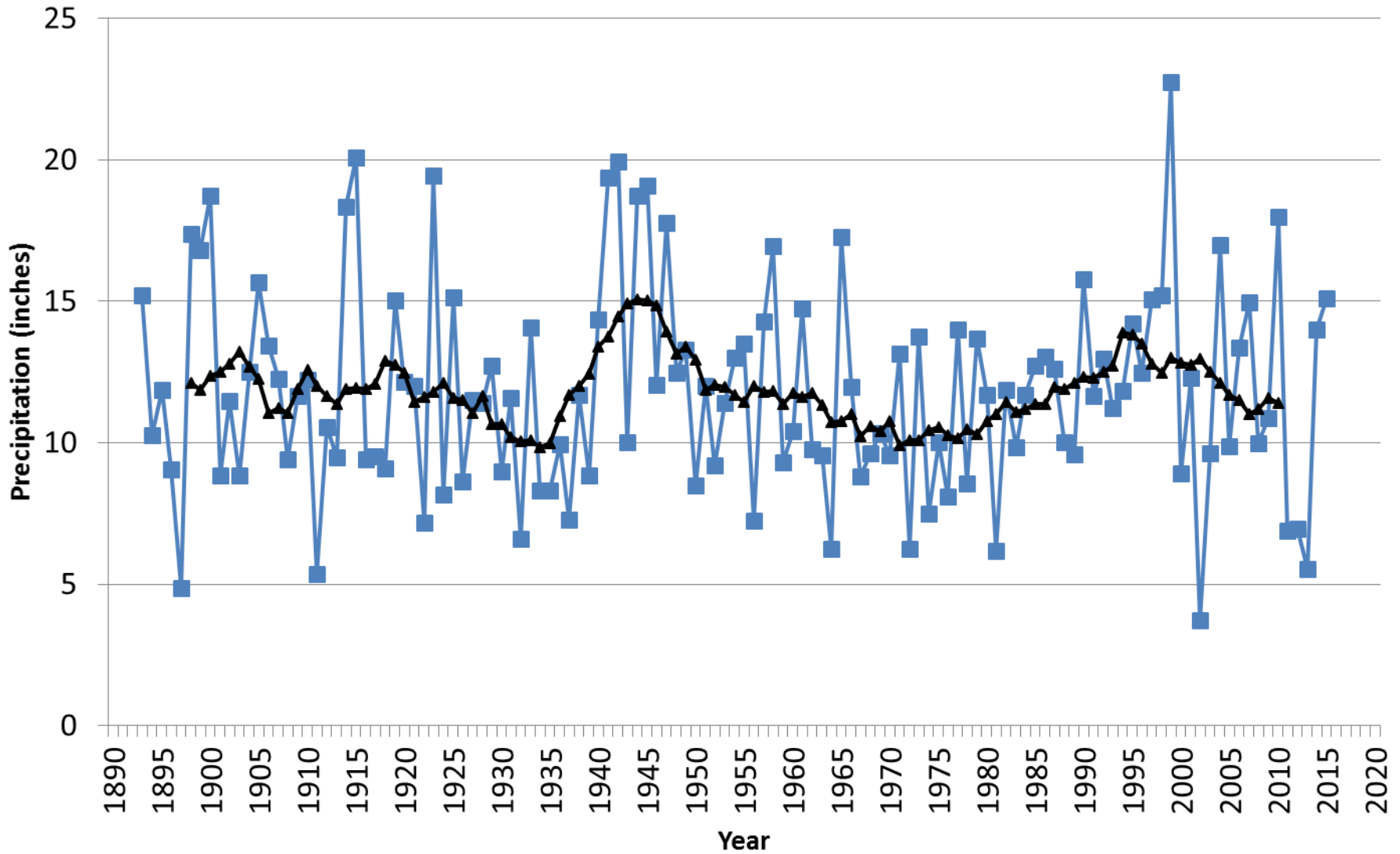
Rocky Ford Monthly Precipitation for Period of Record (1988-2012)



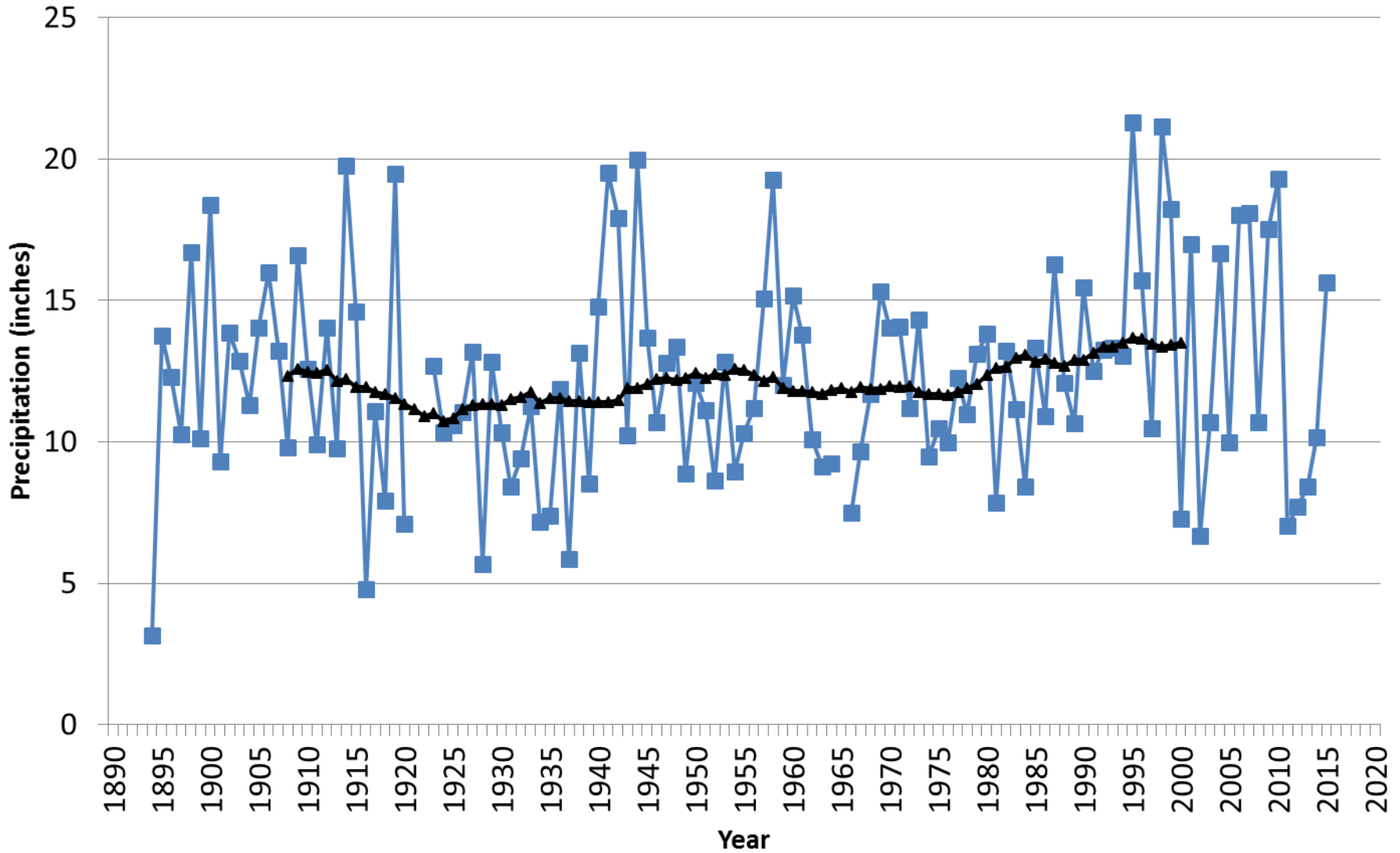
Rocky Ford Water Year Precipitation with Running 30-Year Average



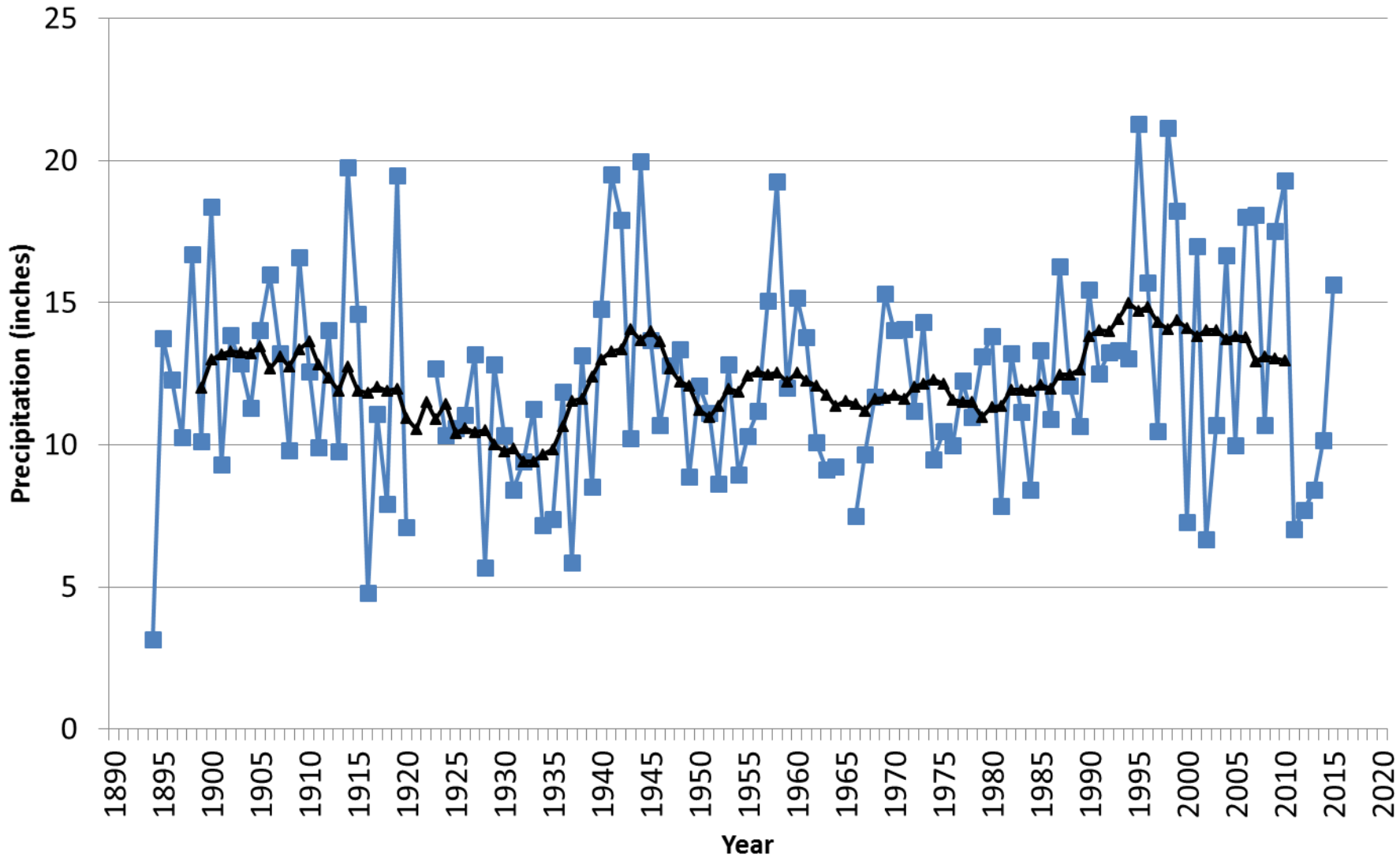
Rocky Ford Water Year Precipitation with Running 11-Year Average



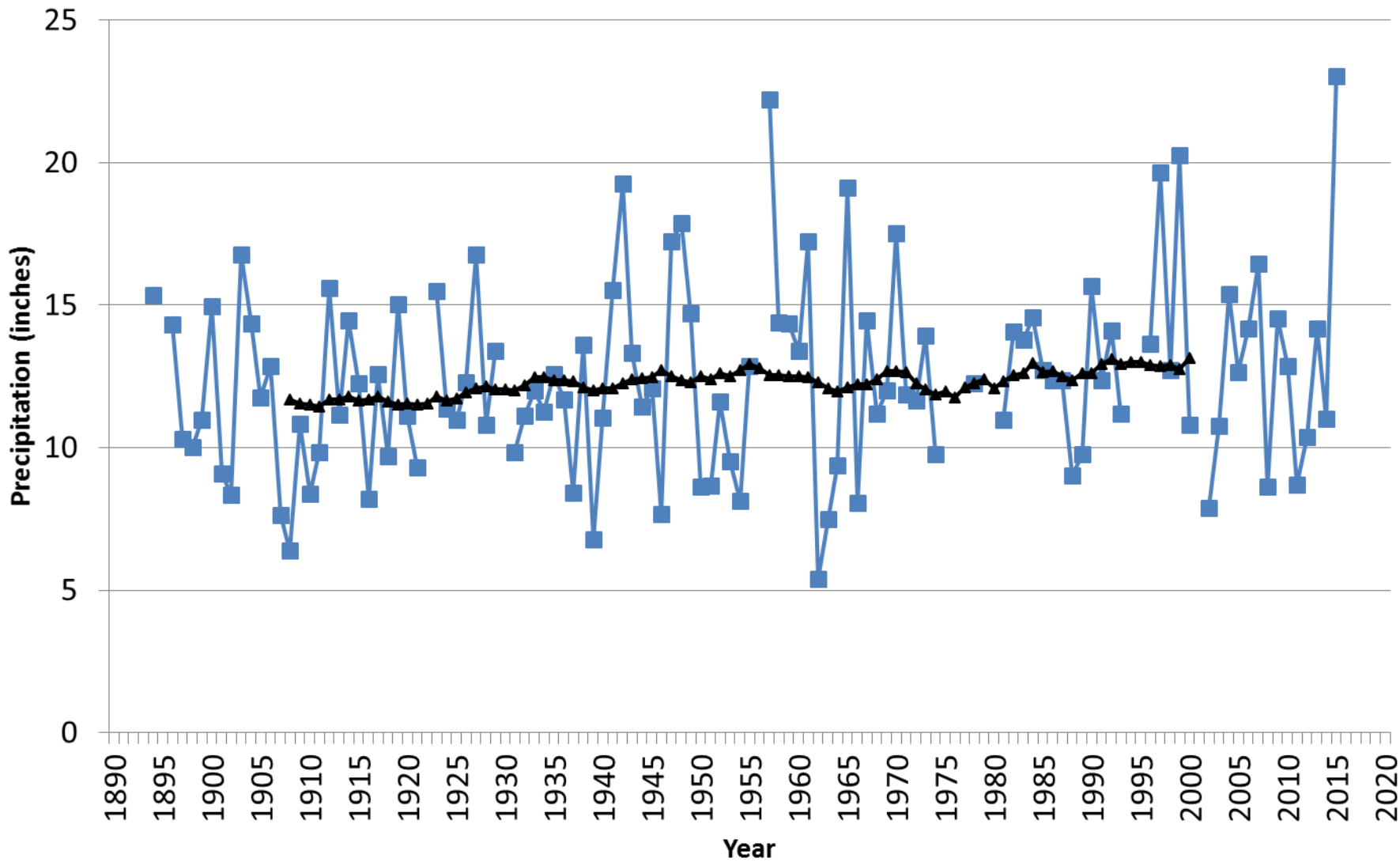
Las Animas Water Year Precipitation with Running 30-Year-Average



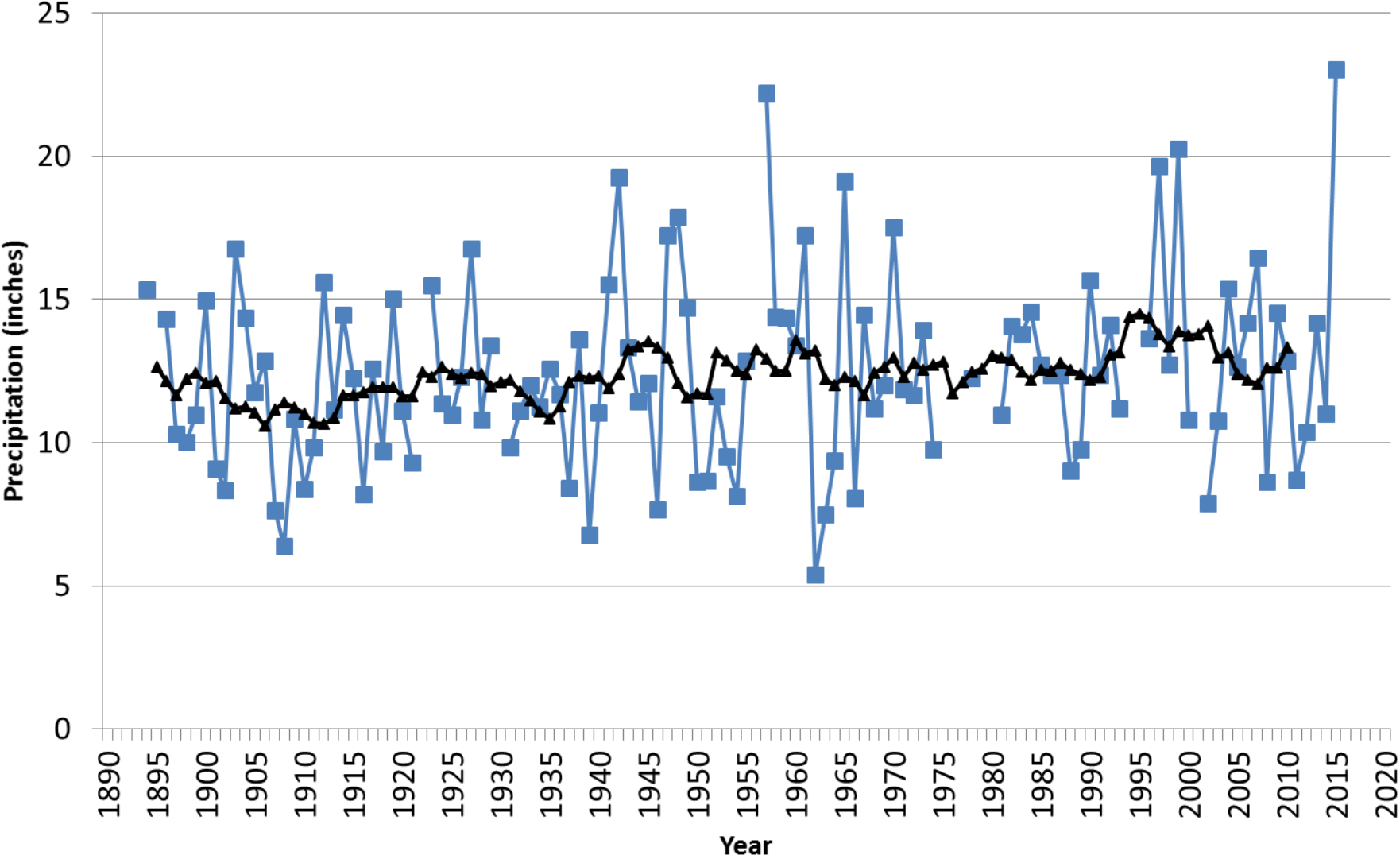
Las Animas Water Year Precipitation with Running 11-Year-Average



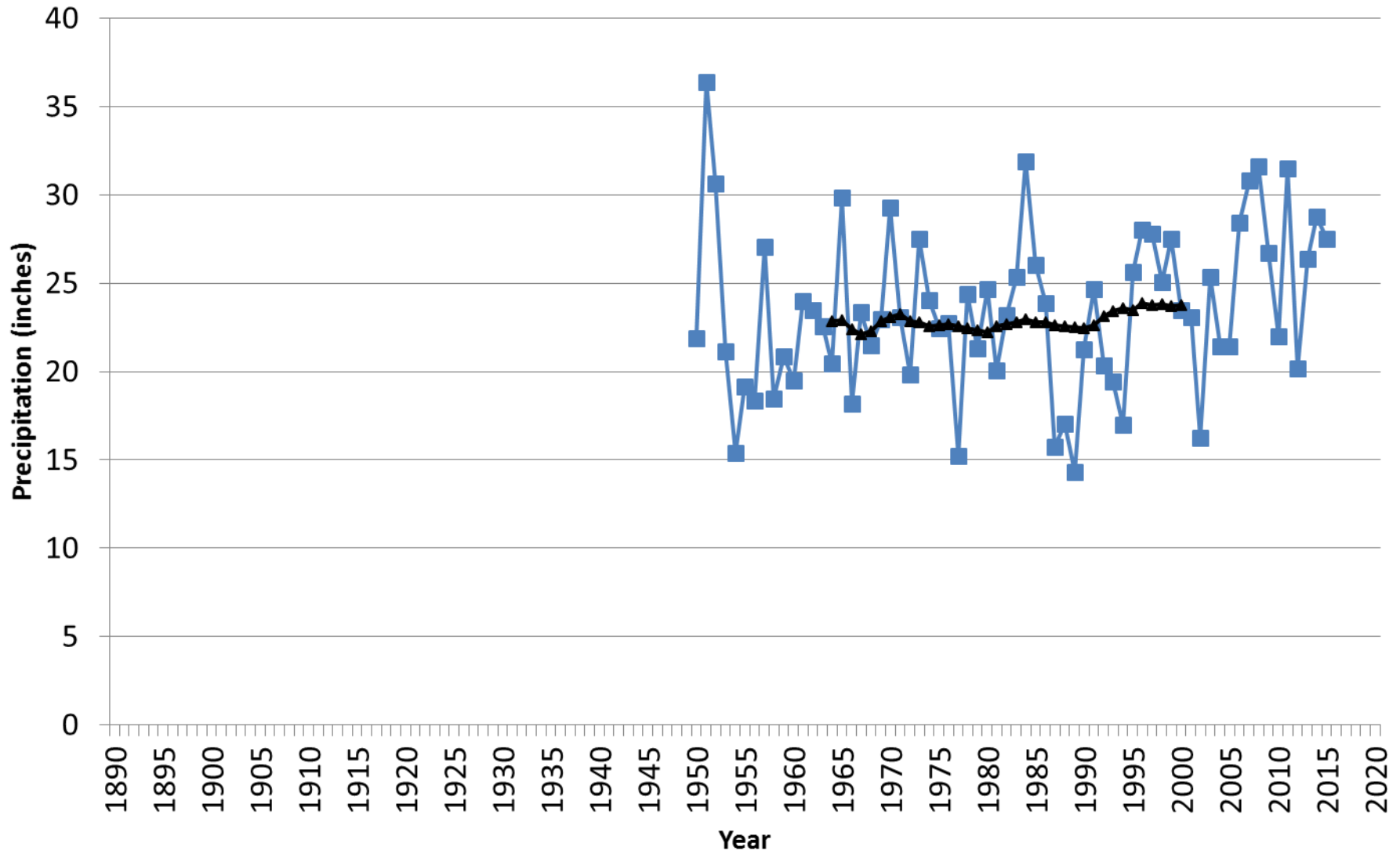
Canon City Water Year Precipitation with Running 30-Year-Average



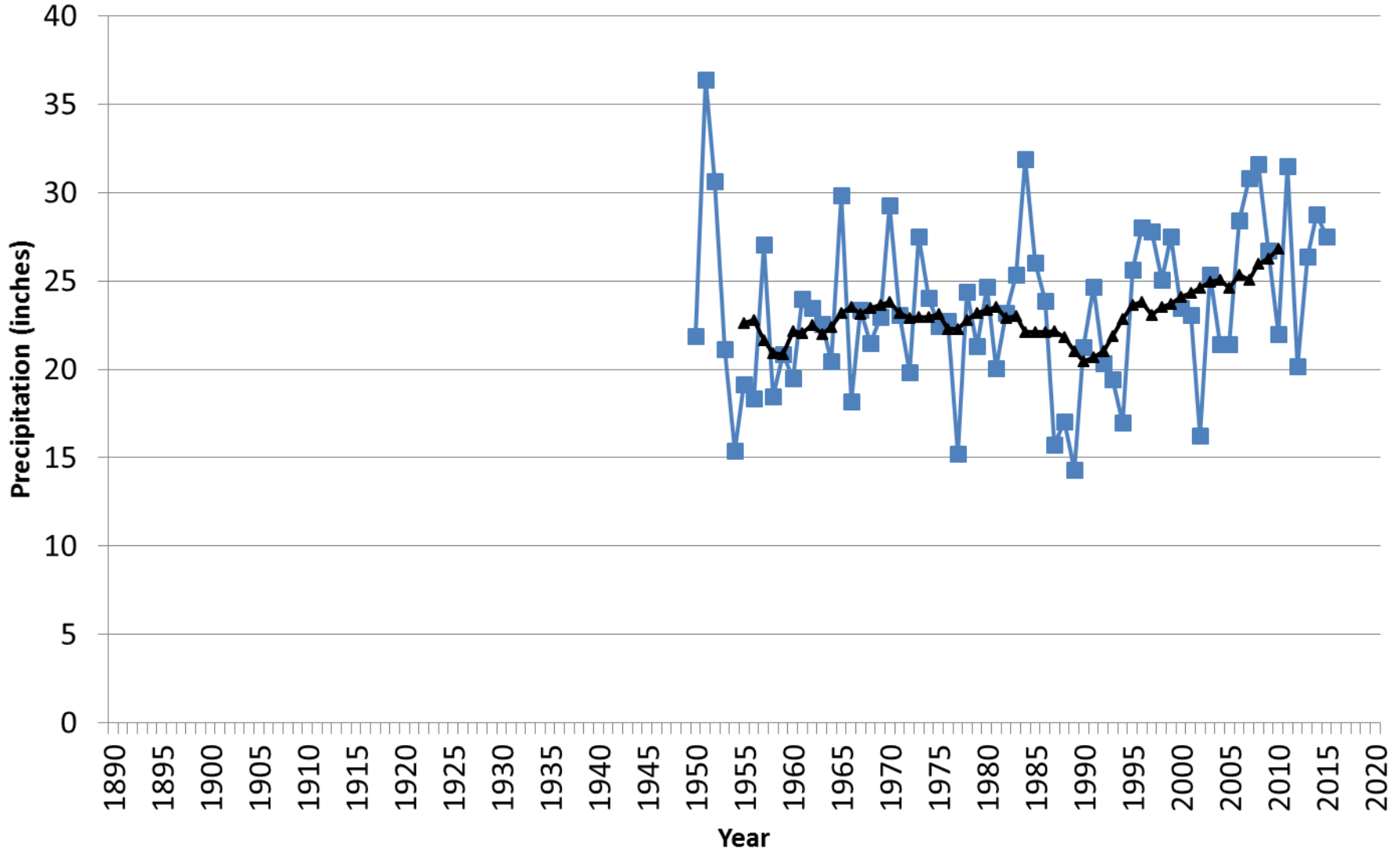
Canon City Water Year Precipitation with Running 11-Year-Average



Climax Water Year Precipitation with Running 30-Year Average

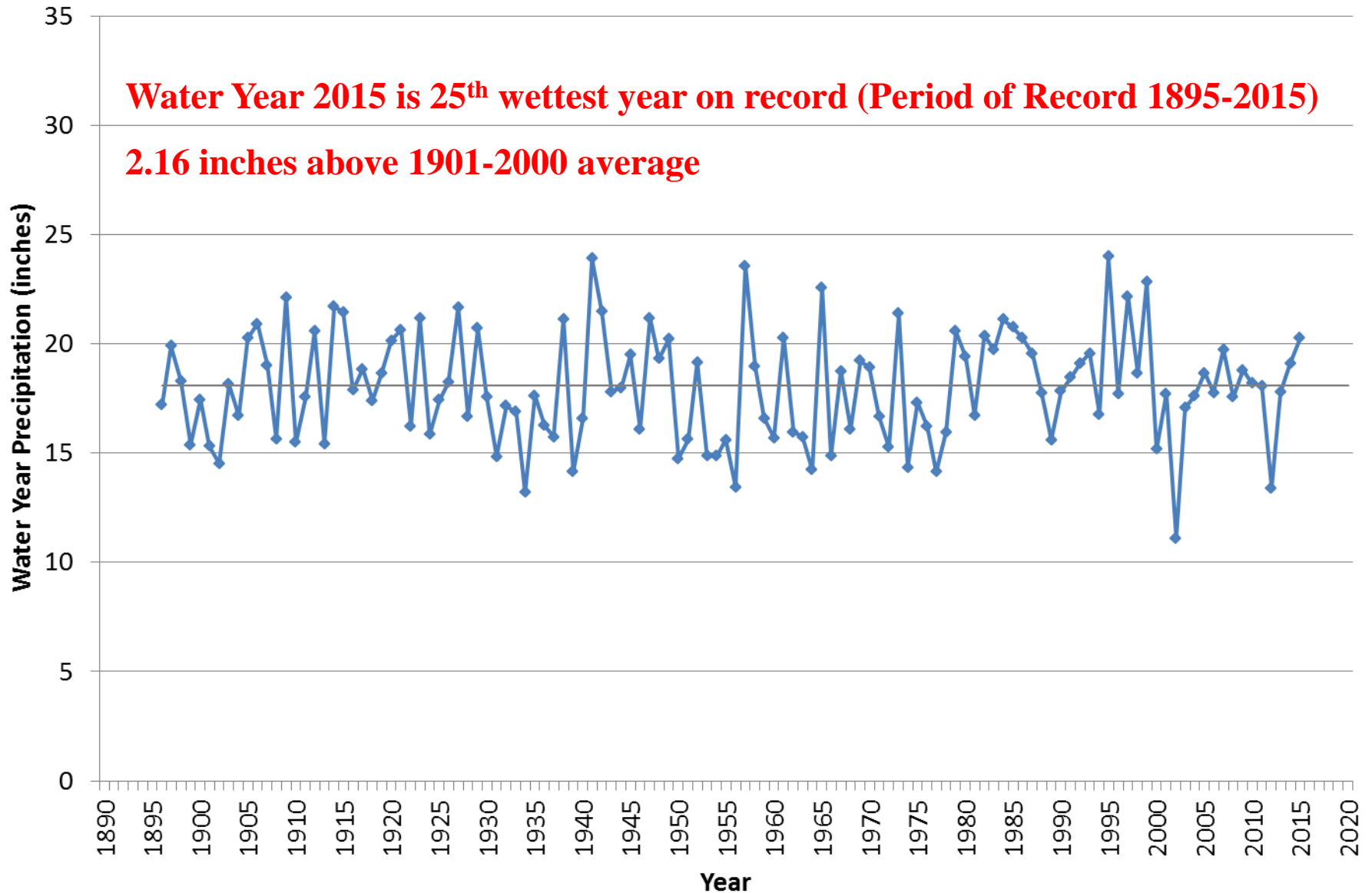


Climax Water Year Precipitation with Running 11-Year Average



Colorado Precipitation in Historic Perspective

Statewide Water Year Precipitation

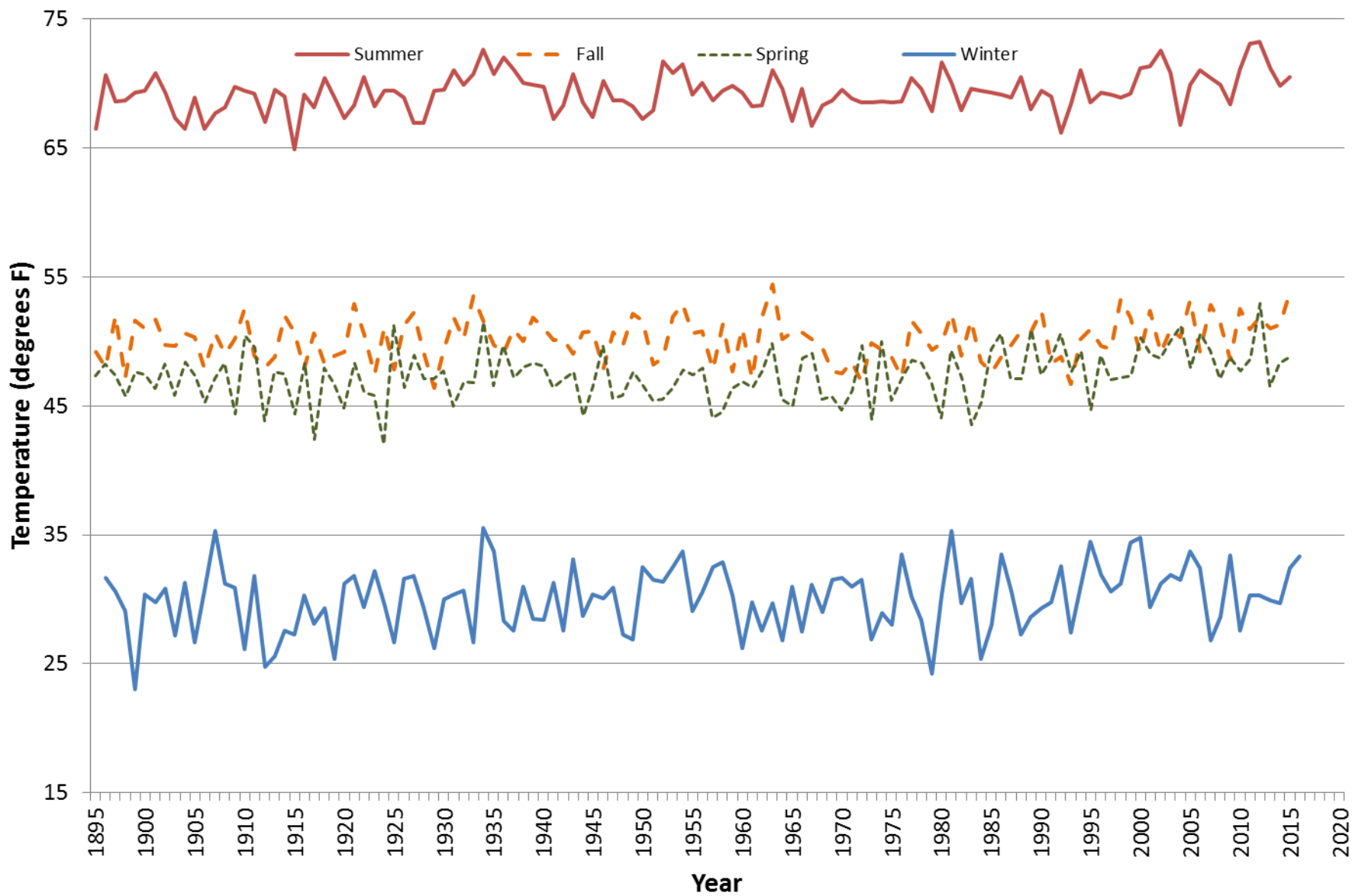




Arkansas River Basin Temperature Fluctuations and Trends

**Fresh off the NOAA
ePresses**

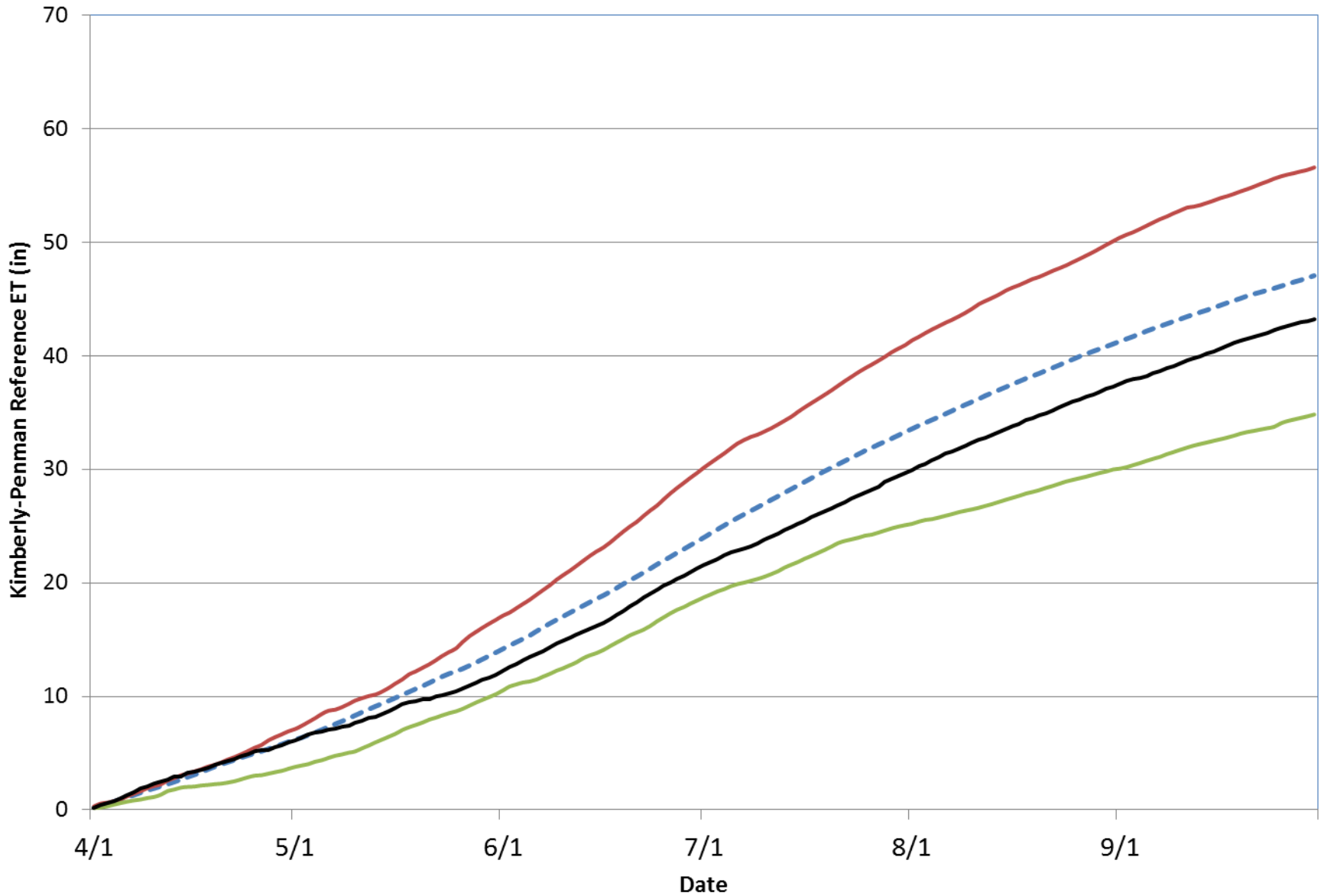
Arkansas Basin Seasonal Temperatures



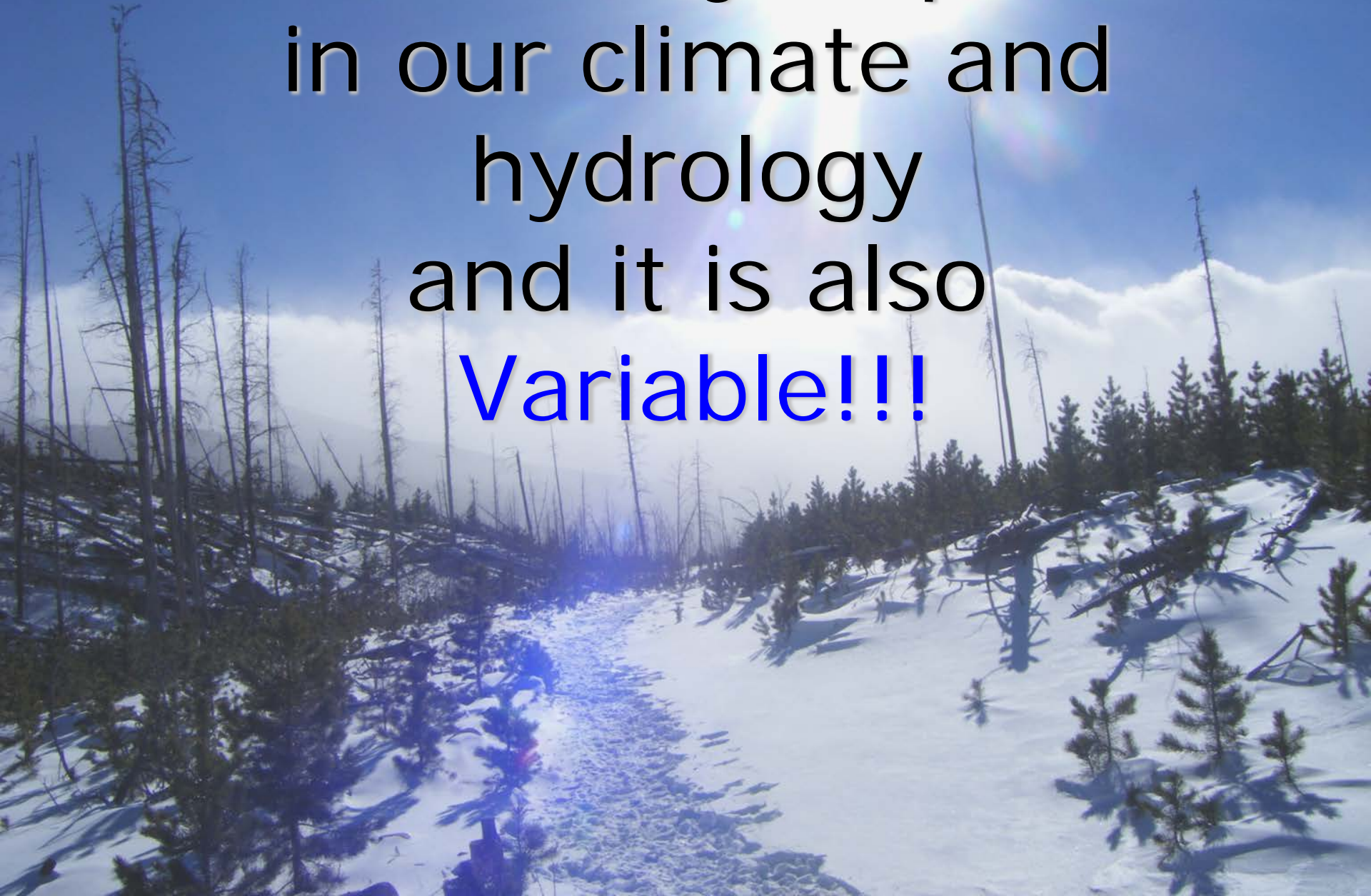
How about ET (Evapotranspiration)

Avondale Kimberly-Penman Reference ET (1993 - 2015)

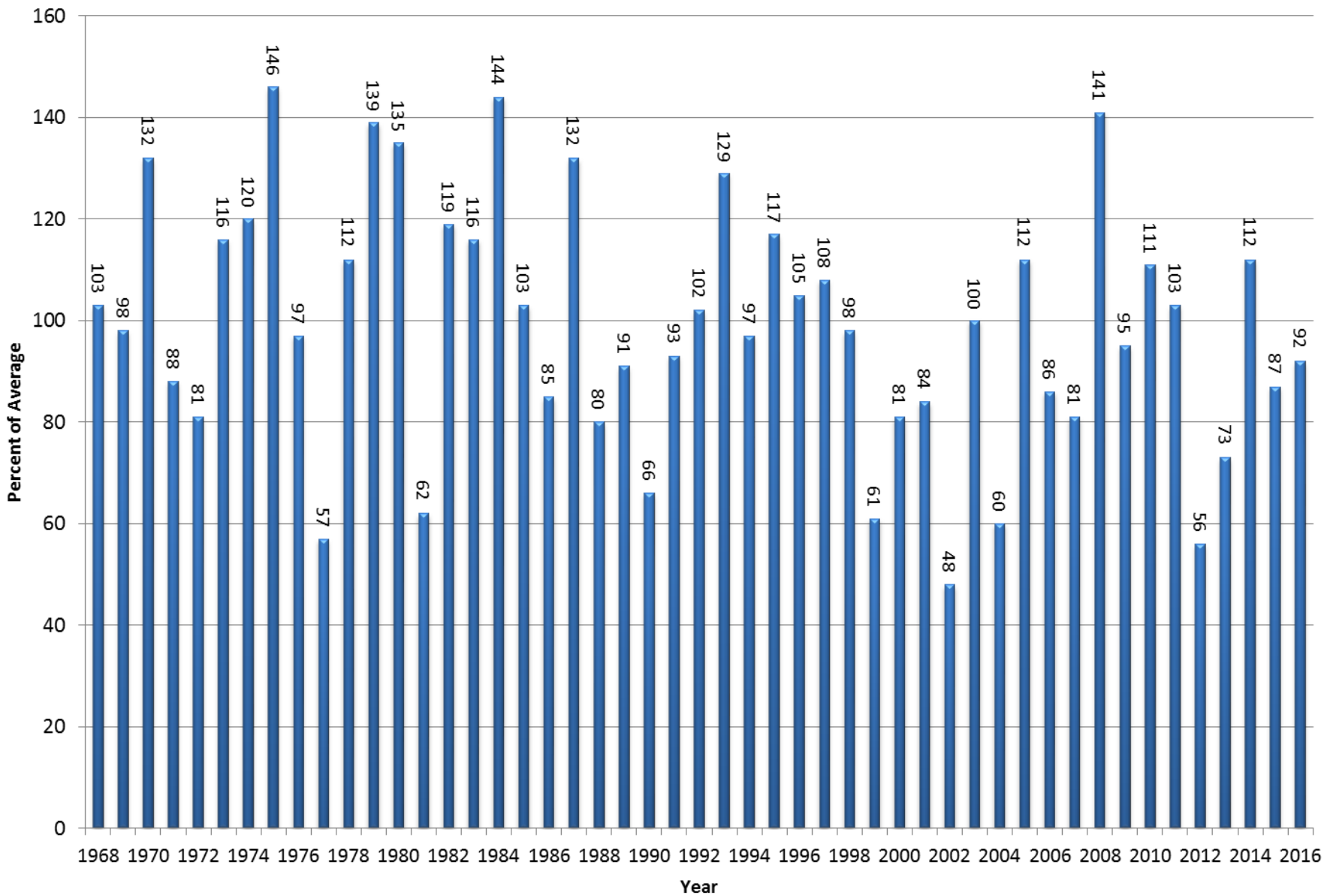
--- Average — 2012 — 1998 — 2015



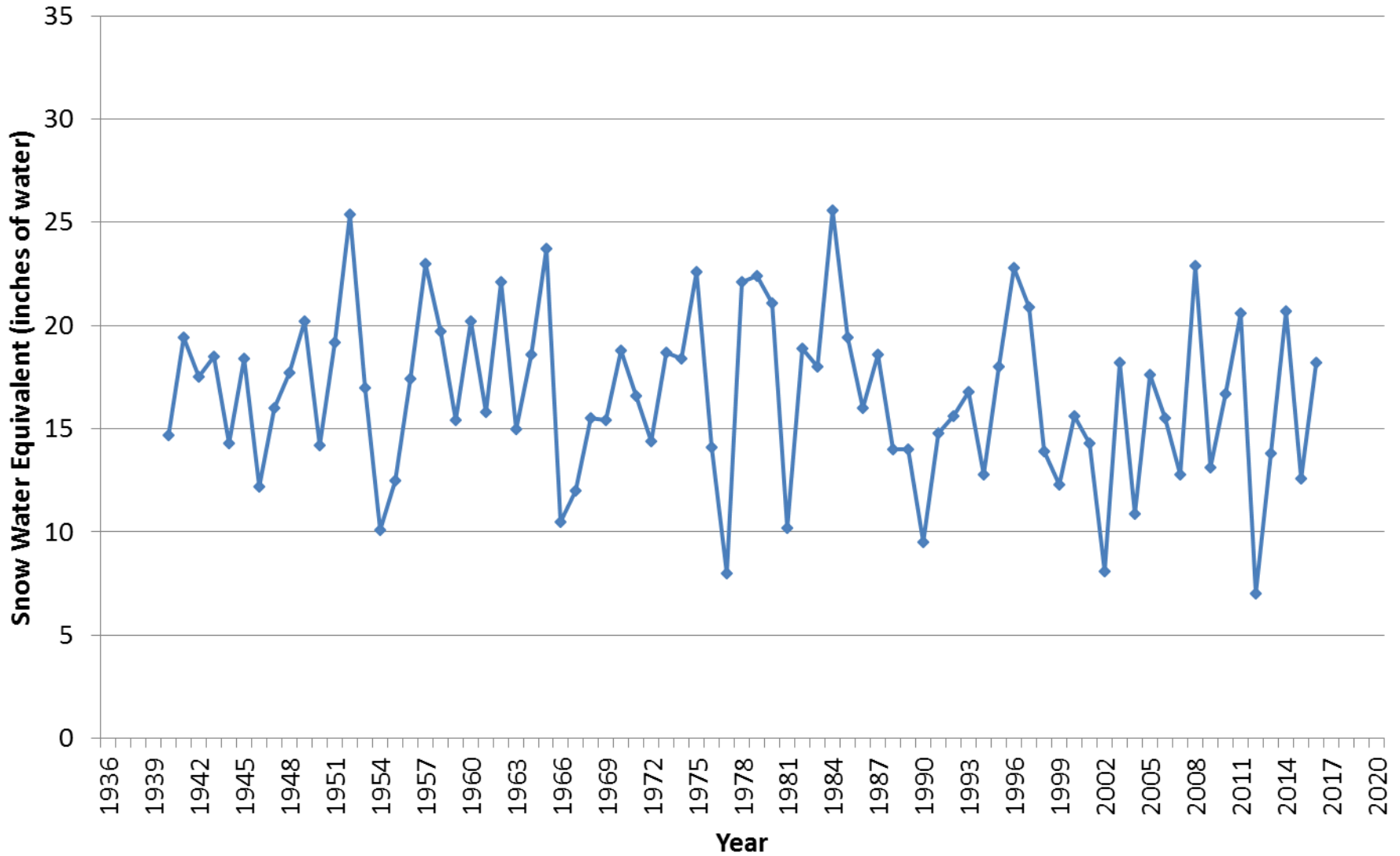
Snow is "Way Important"
in our climate and
hydrology
and it is also
Variable!!!



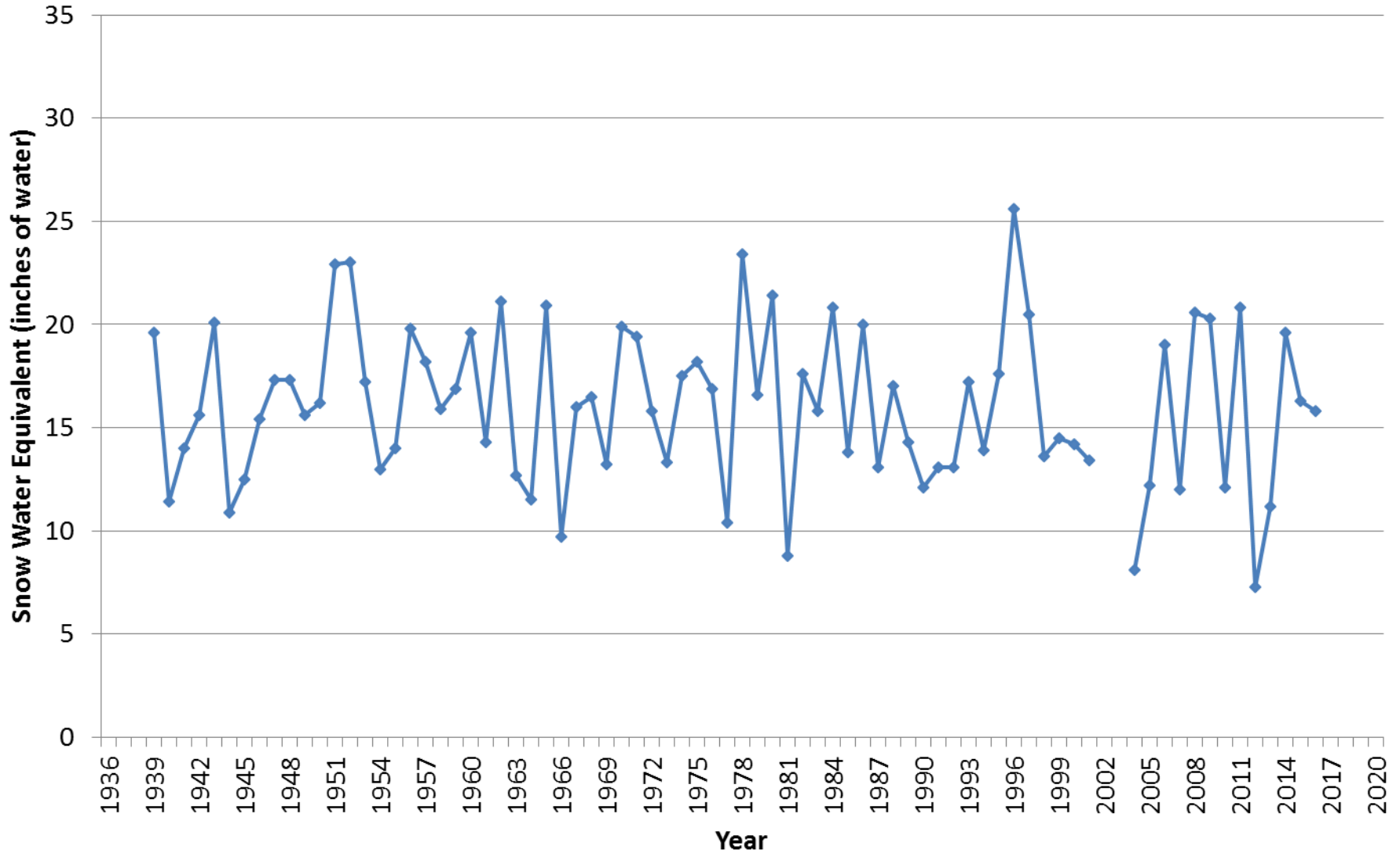
April 1 Total Arkansas Snowpack



Porphyry Creek Snow Course April 1 Snow Water Equivalent



Fremont Pass Snow Course April 1 Snow Water Equivalent

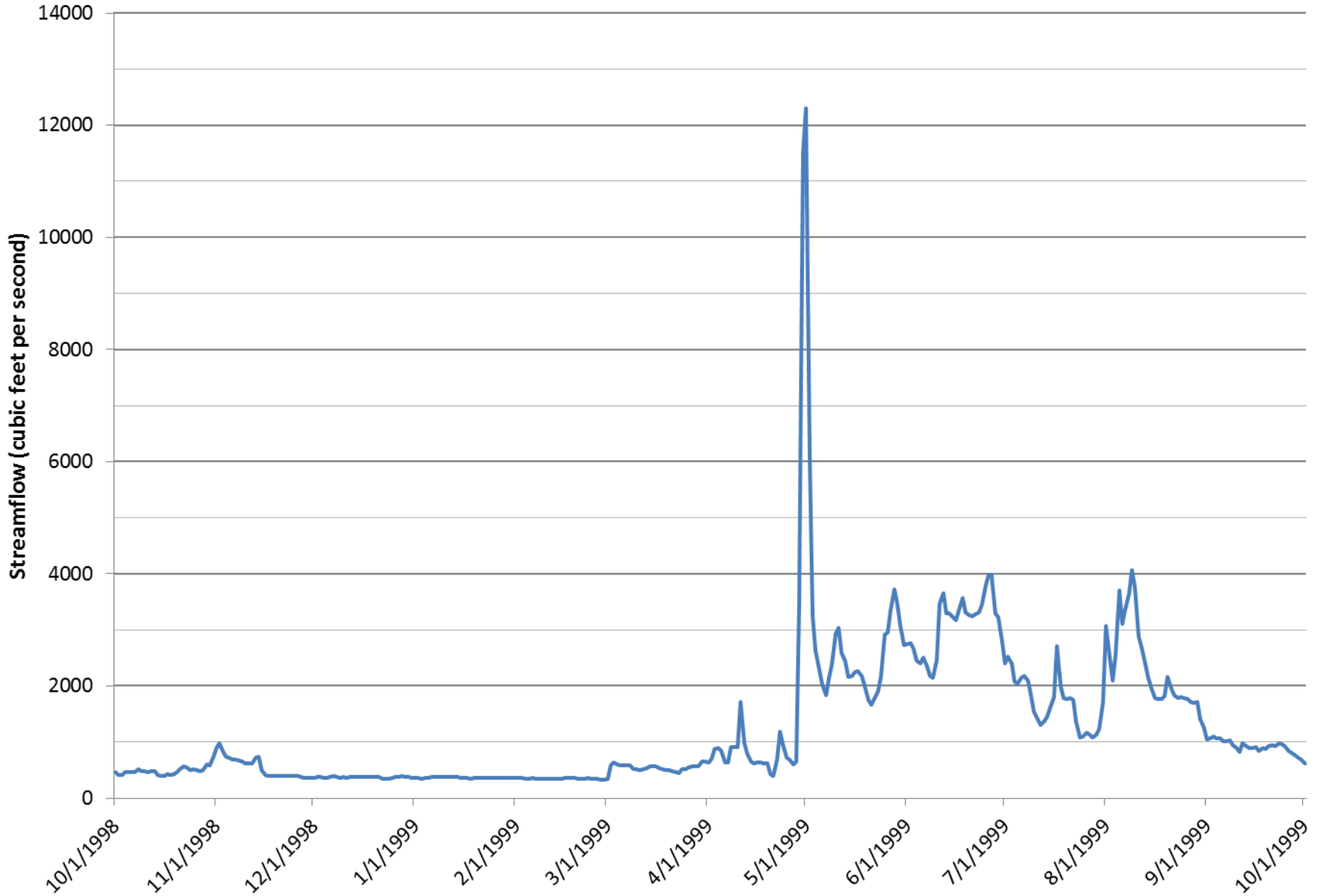


Streamflow

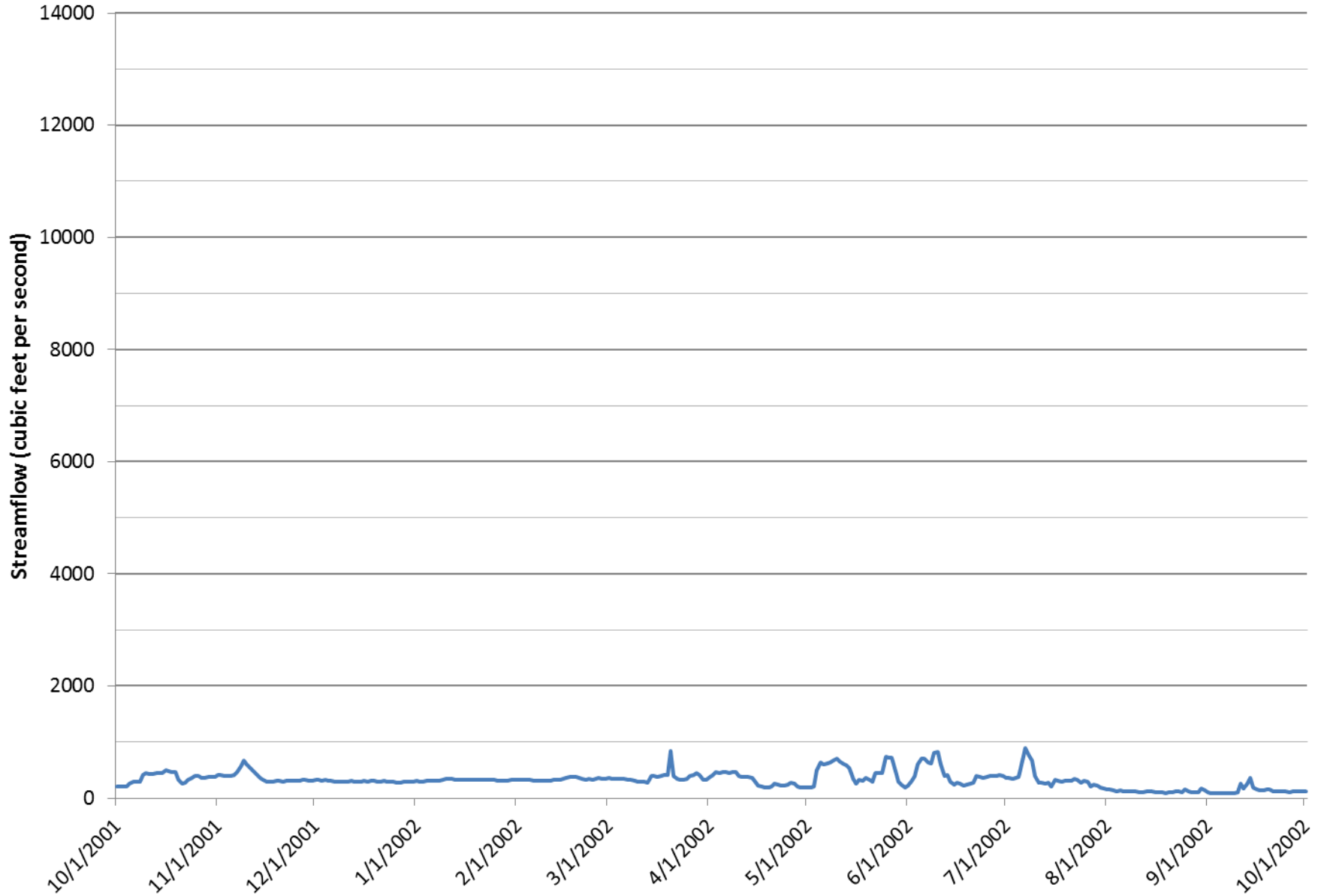
The great
“integrator”
of the water
budget



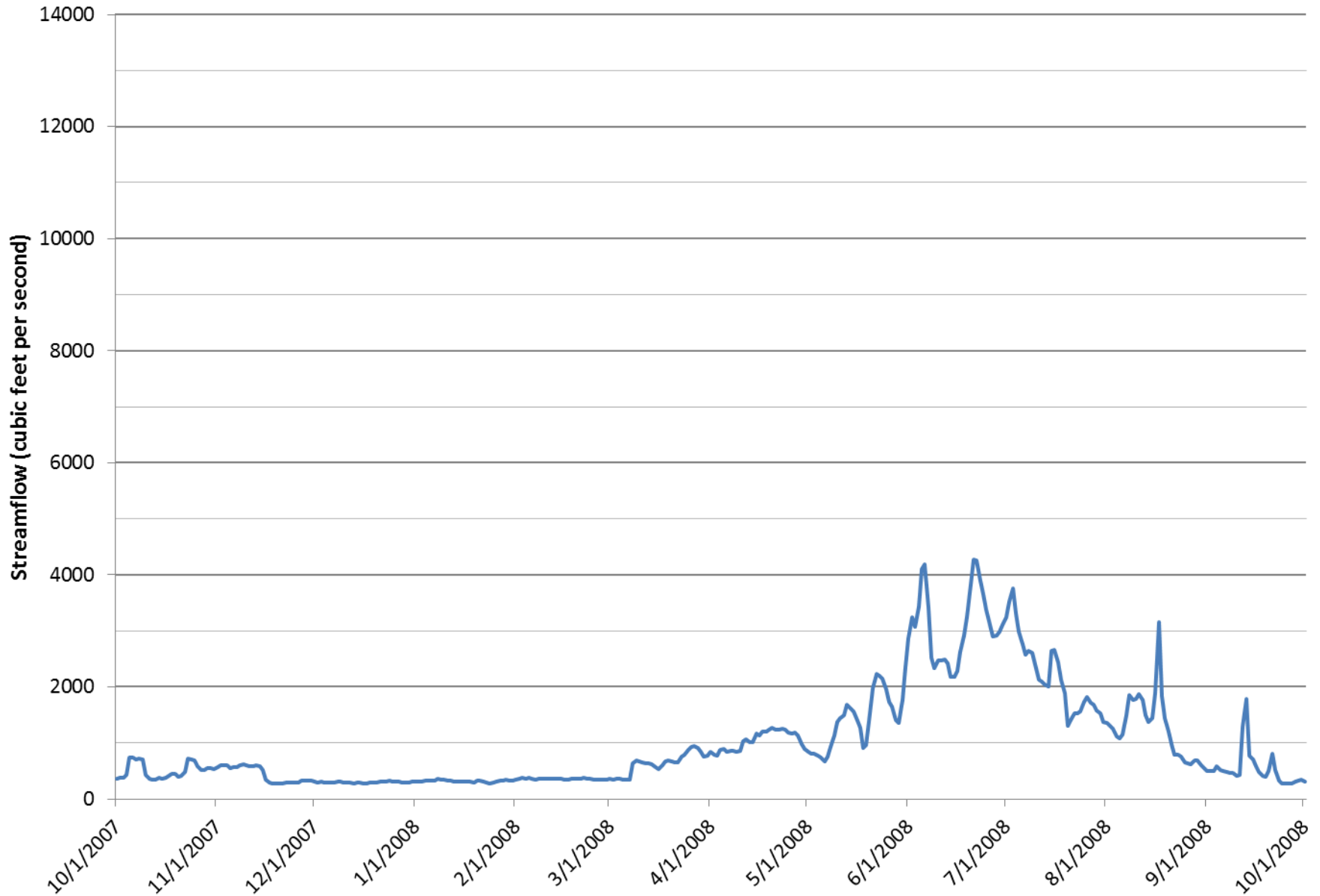
Arkansas River near Avondale, CO Streamflow, WY 1999



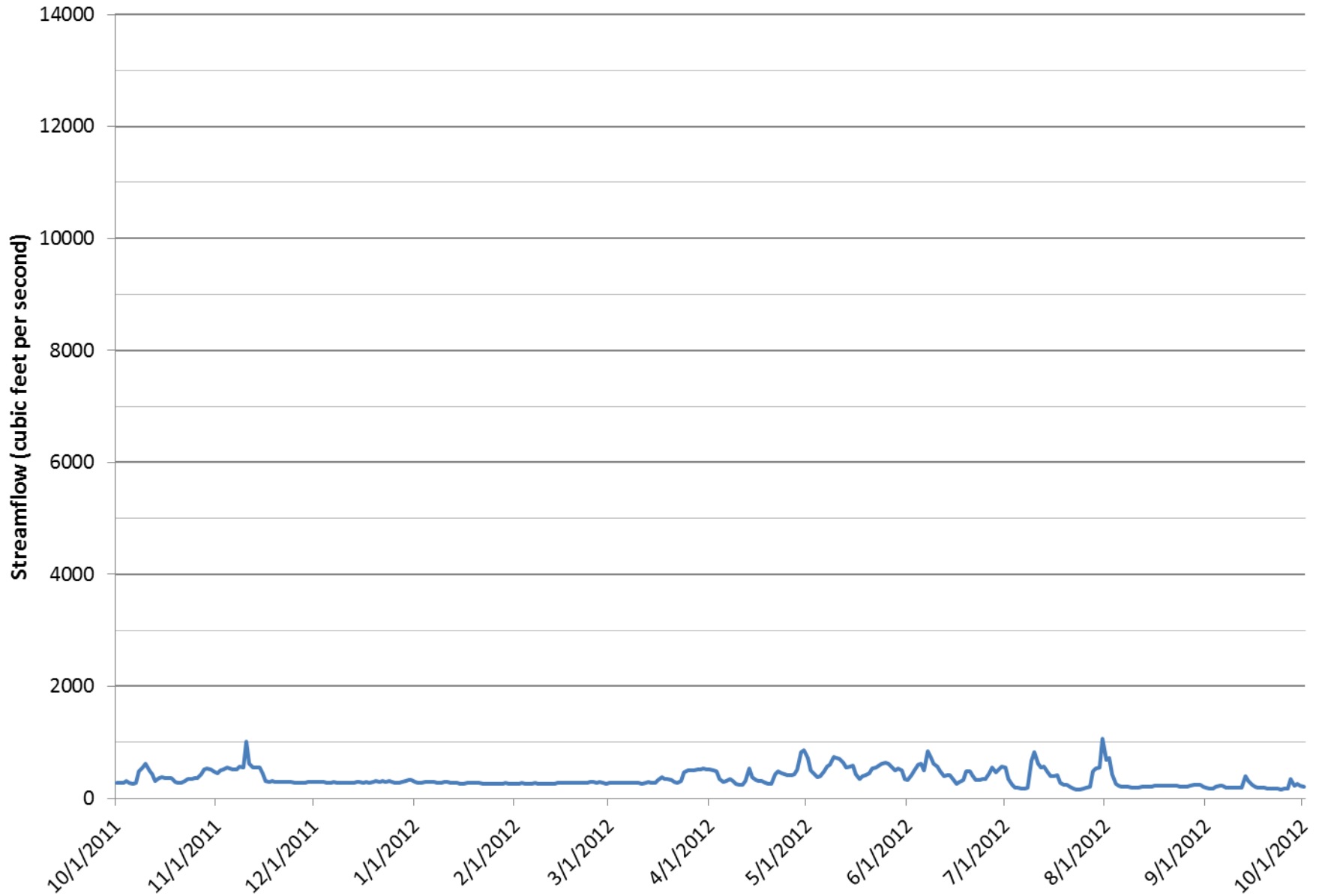
Arkansas River near Avondale, CO Streamflow, WY 2002



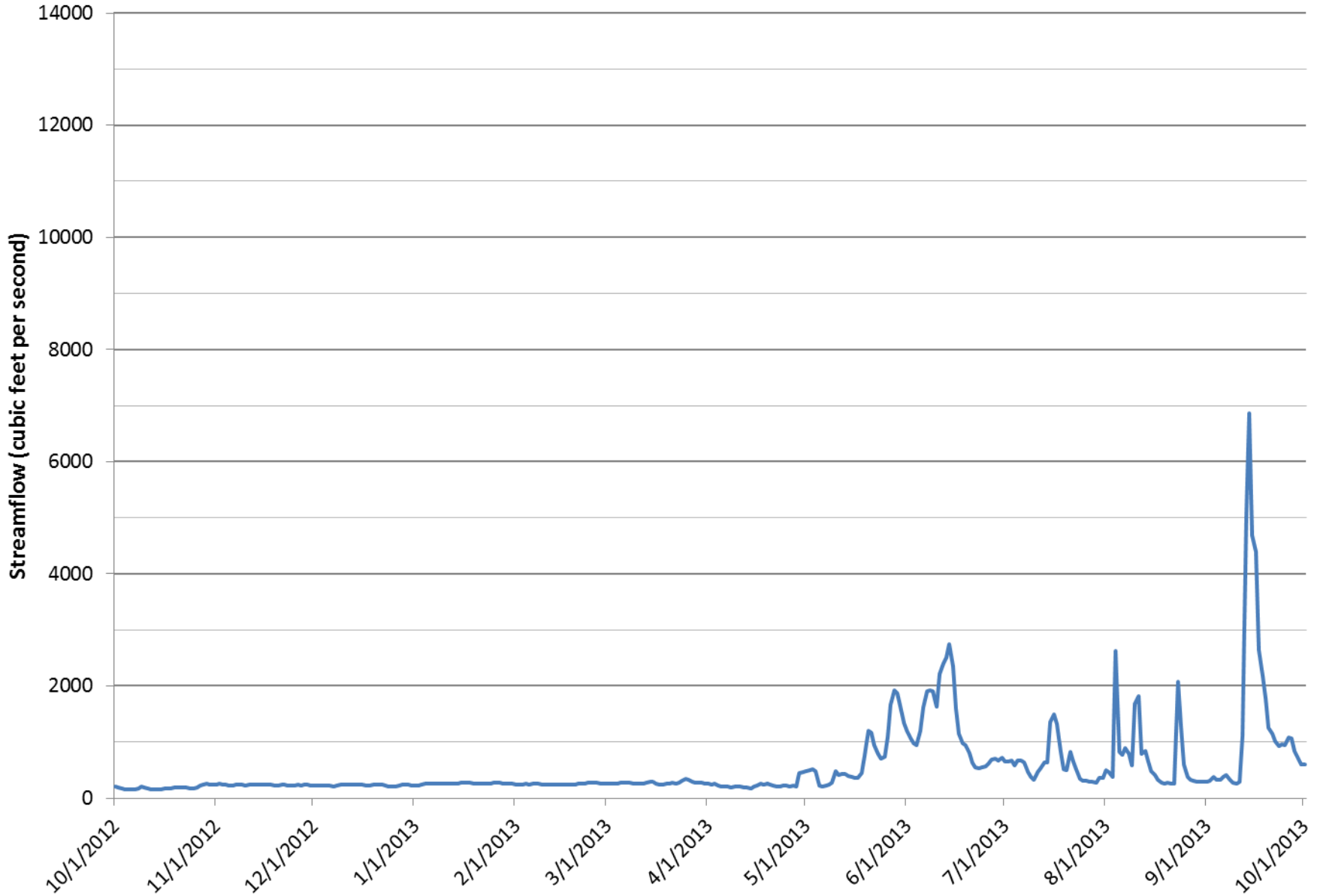
Arkansas near Avondale, CO Streamflow, WY 2008



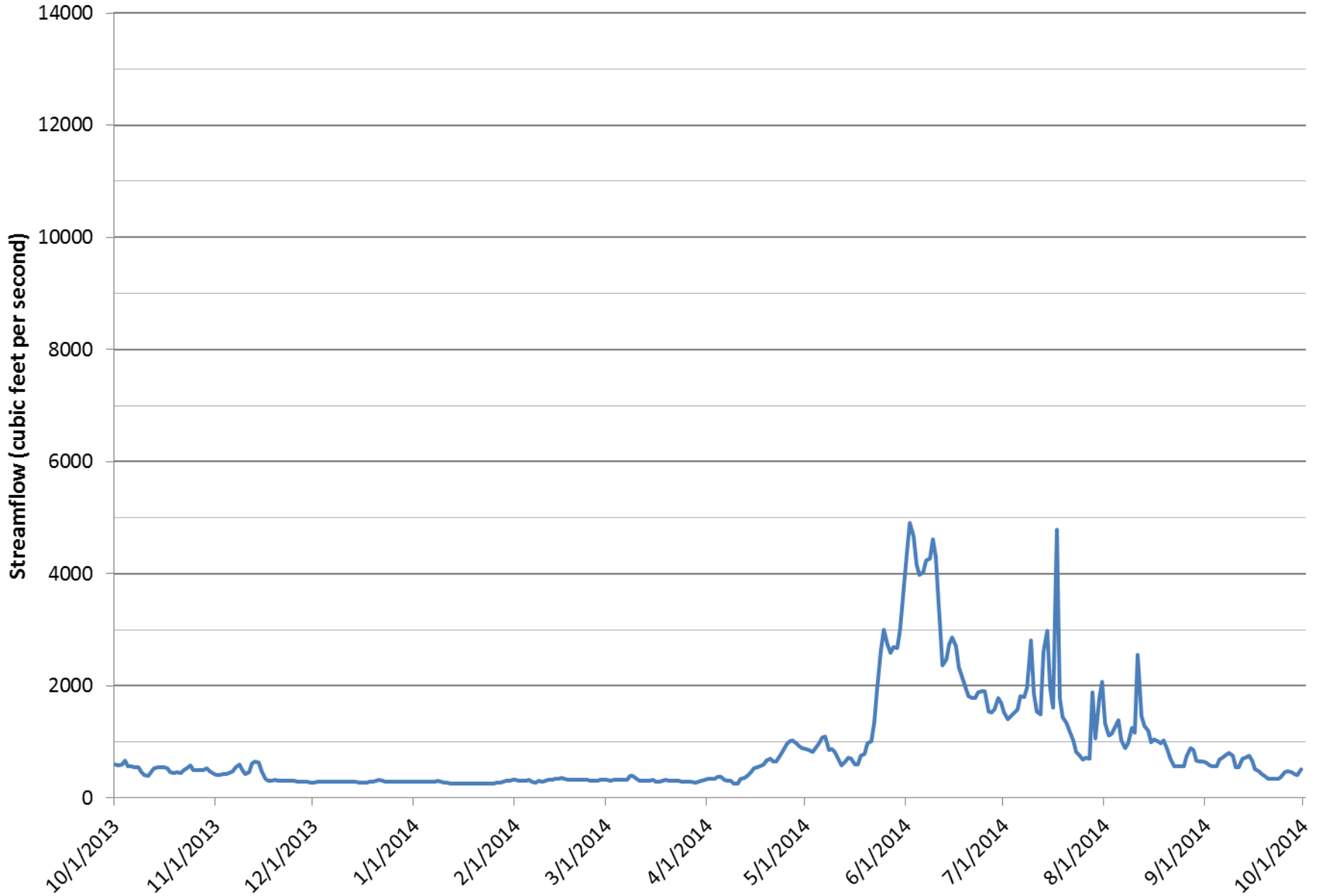
Arkansas near Avondale, CO Streamflow, WY 2012



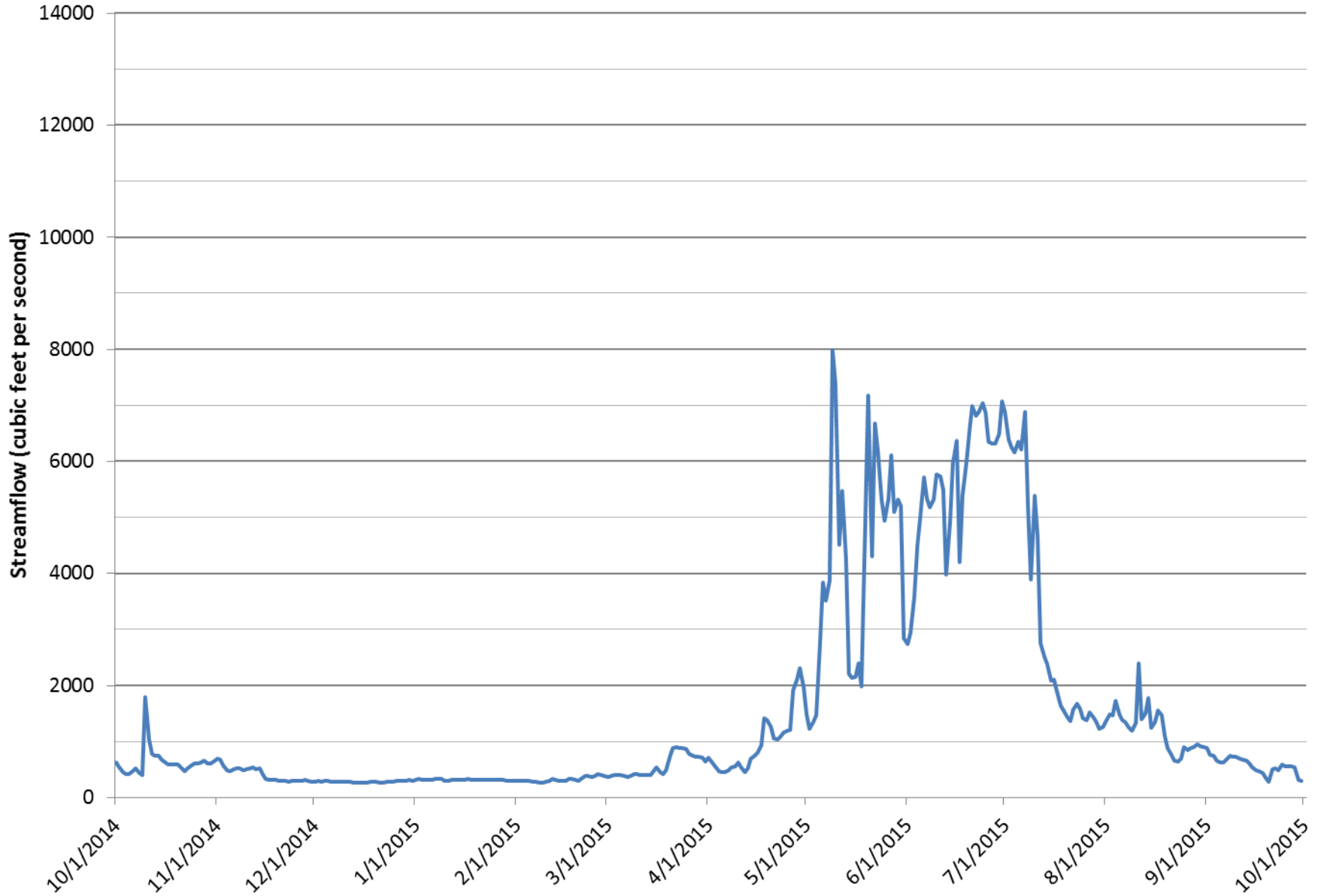
Arkansas River near Avondale, CO Streamflow, WY 2013



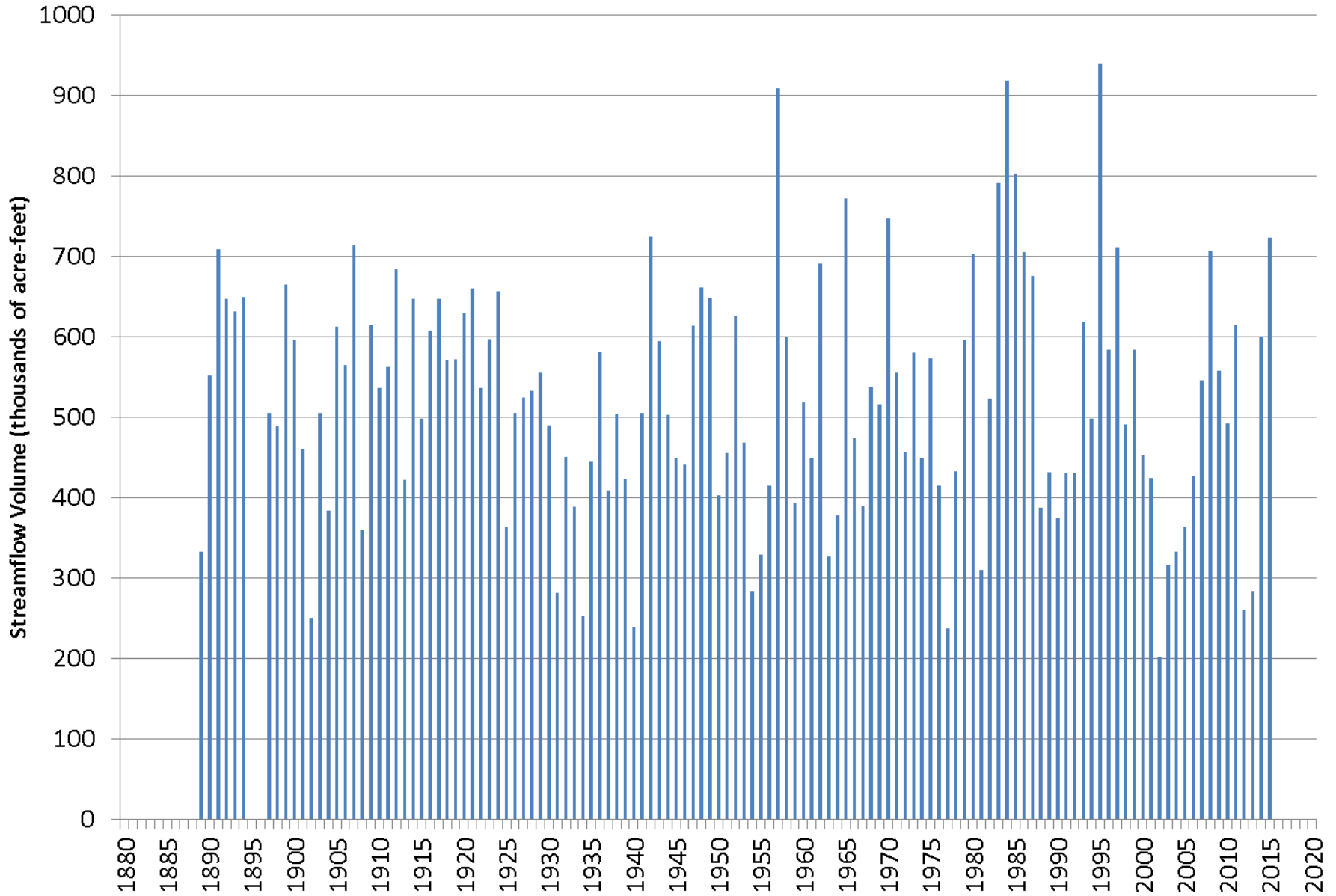
Arkansas River near Avondale, CO Streamflow, WY 2014



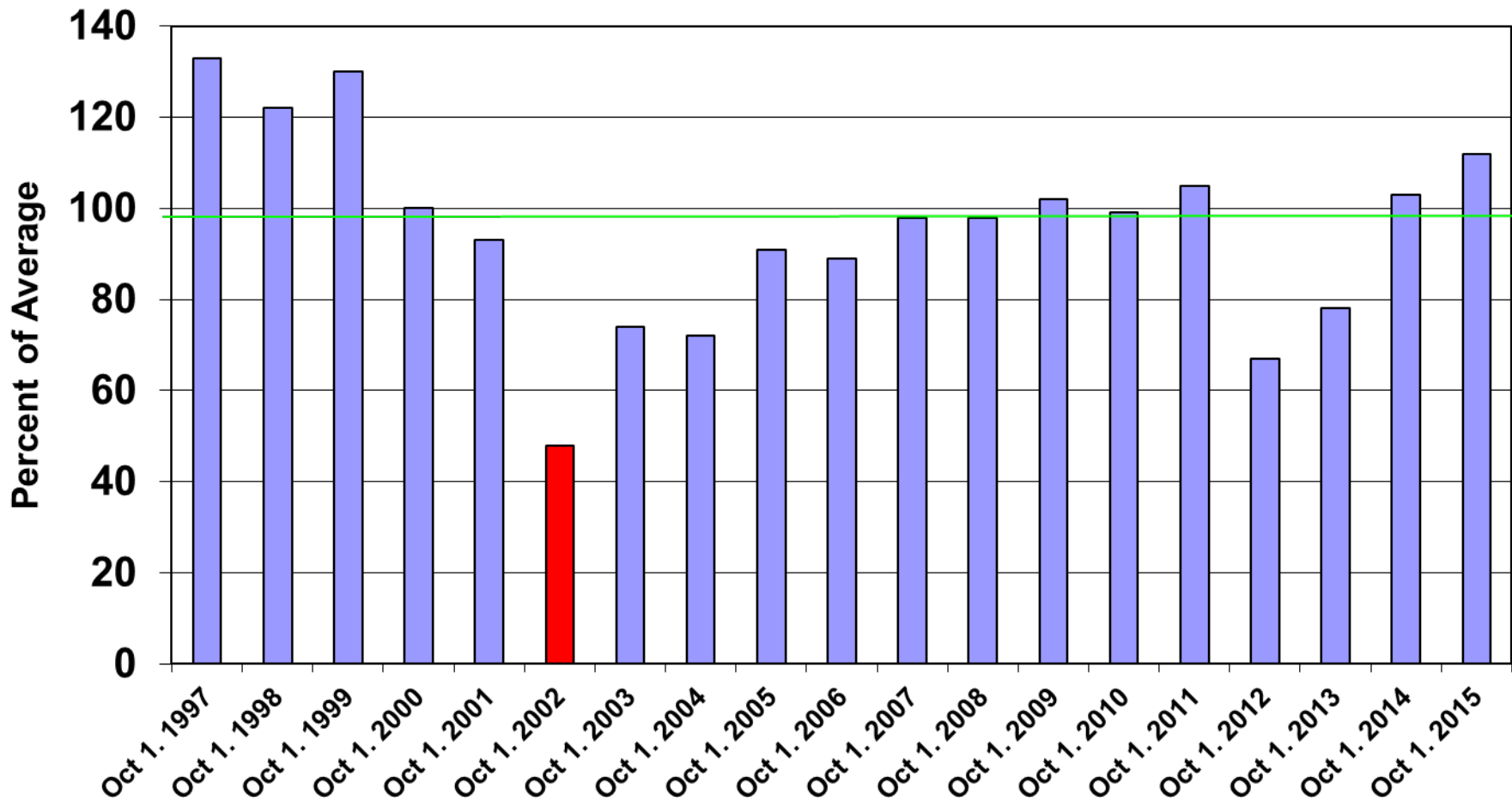
Arkansas River near Avondale, CO Streamflow, WY 2015



Arkansas River at Cañon City Water Year Streamflow



Colorado Statewide Reservoir Levels on October 1st for Years 1997- 2015

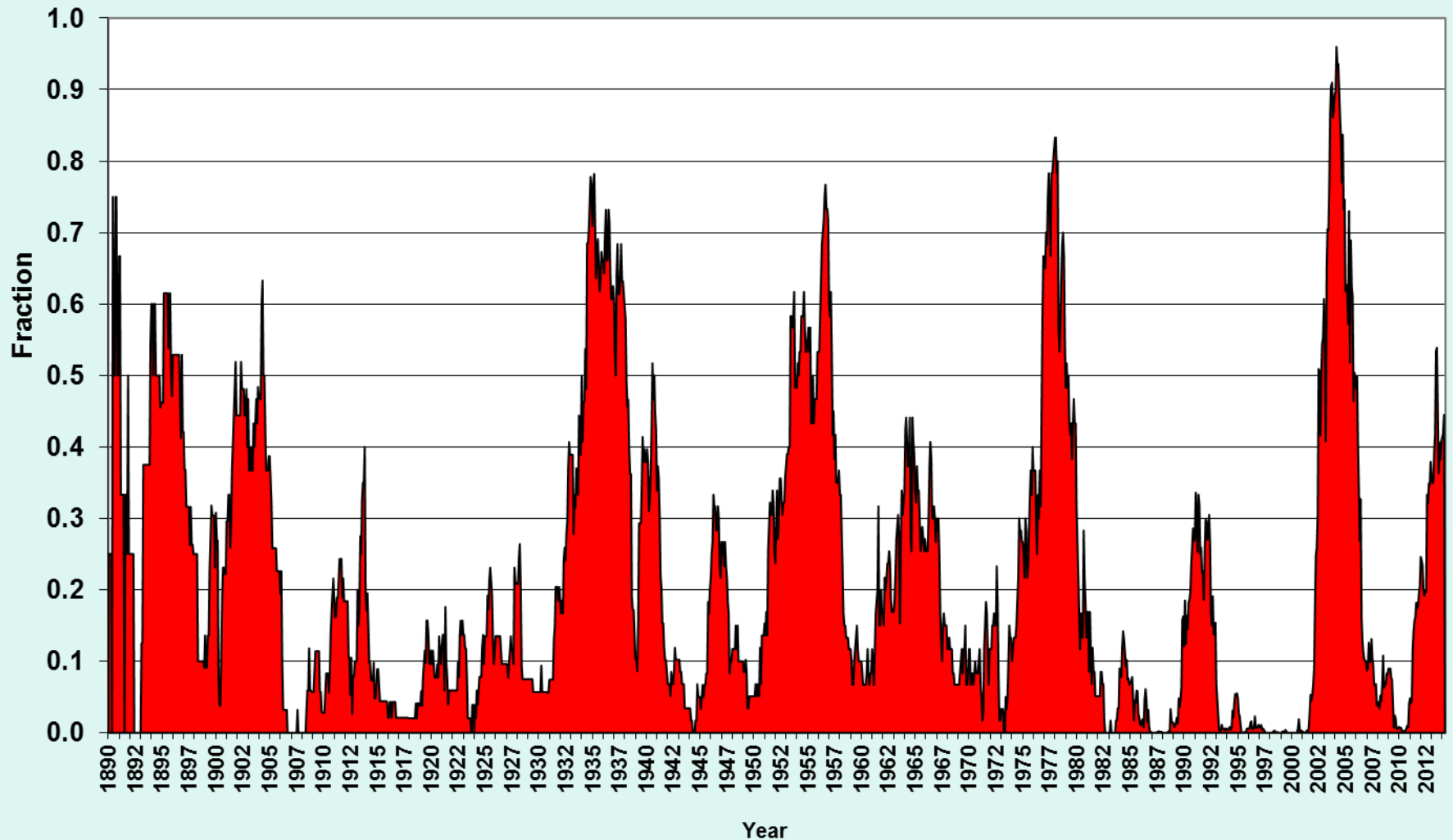


Evolution of Recent Drought Conditions

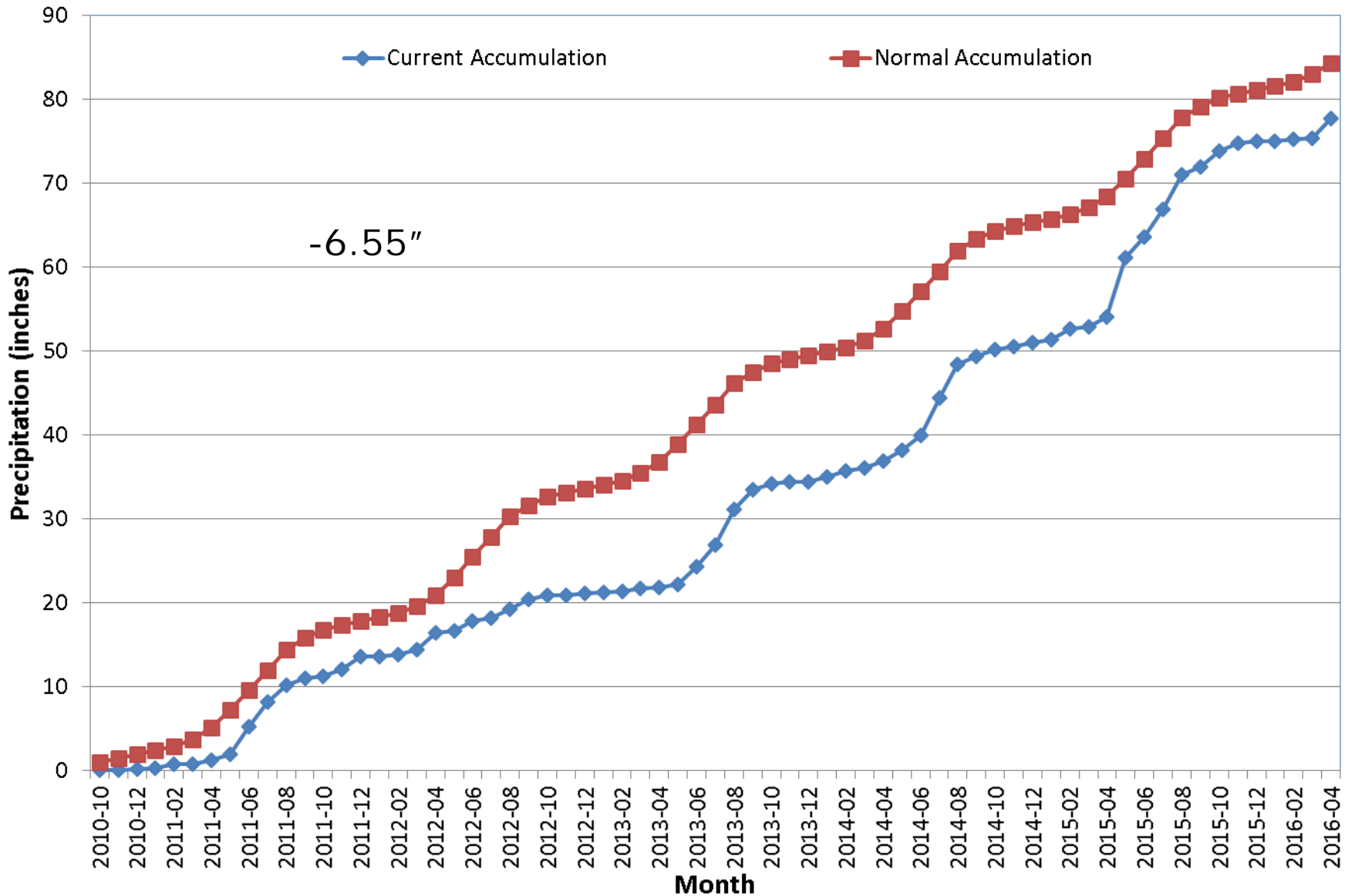
Fraction of Colorado in Drought

Based on 48 month SPI (SPI <-1)

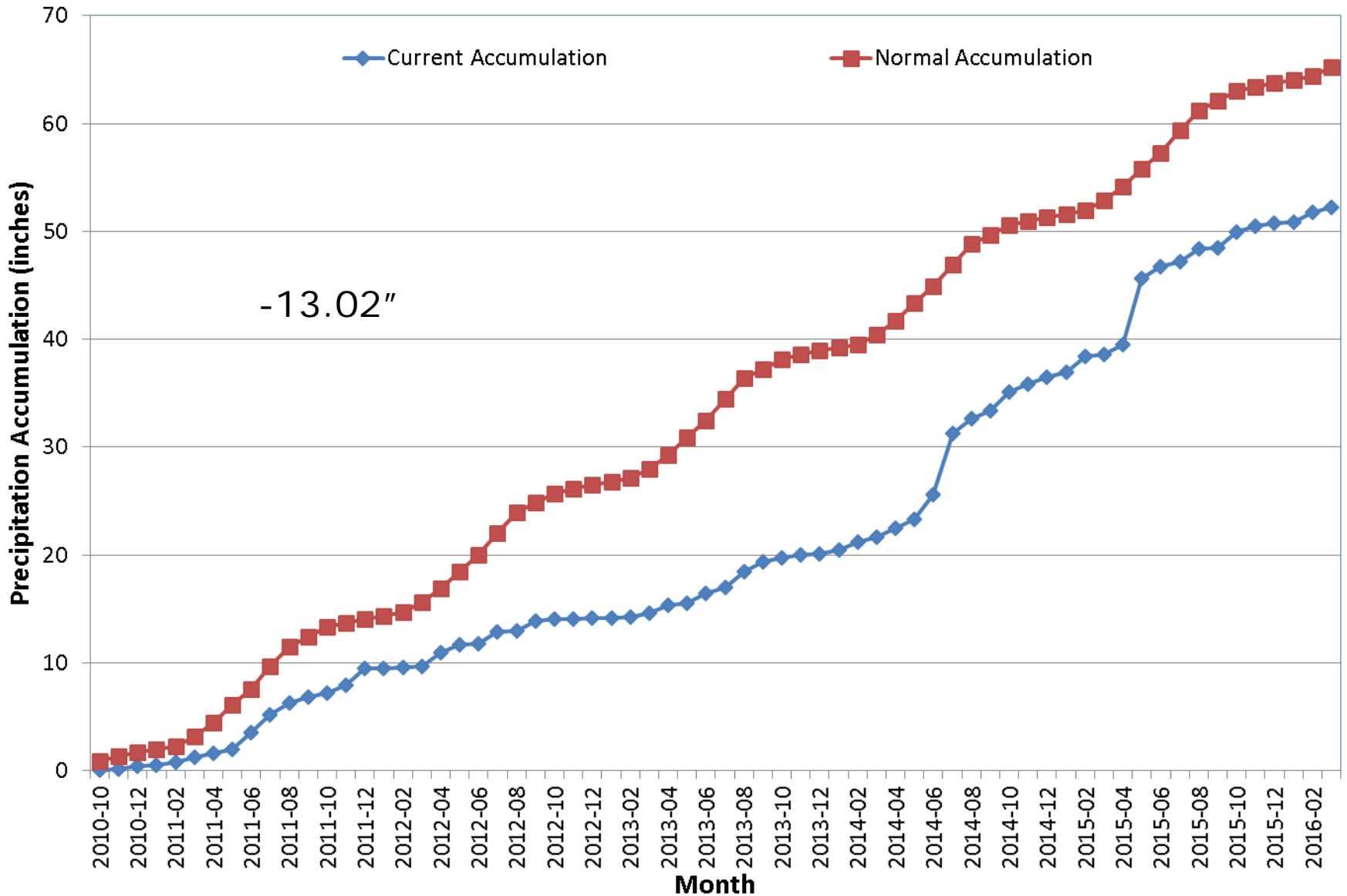
(1890 - March 2014)



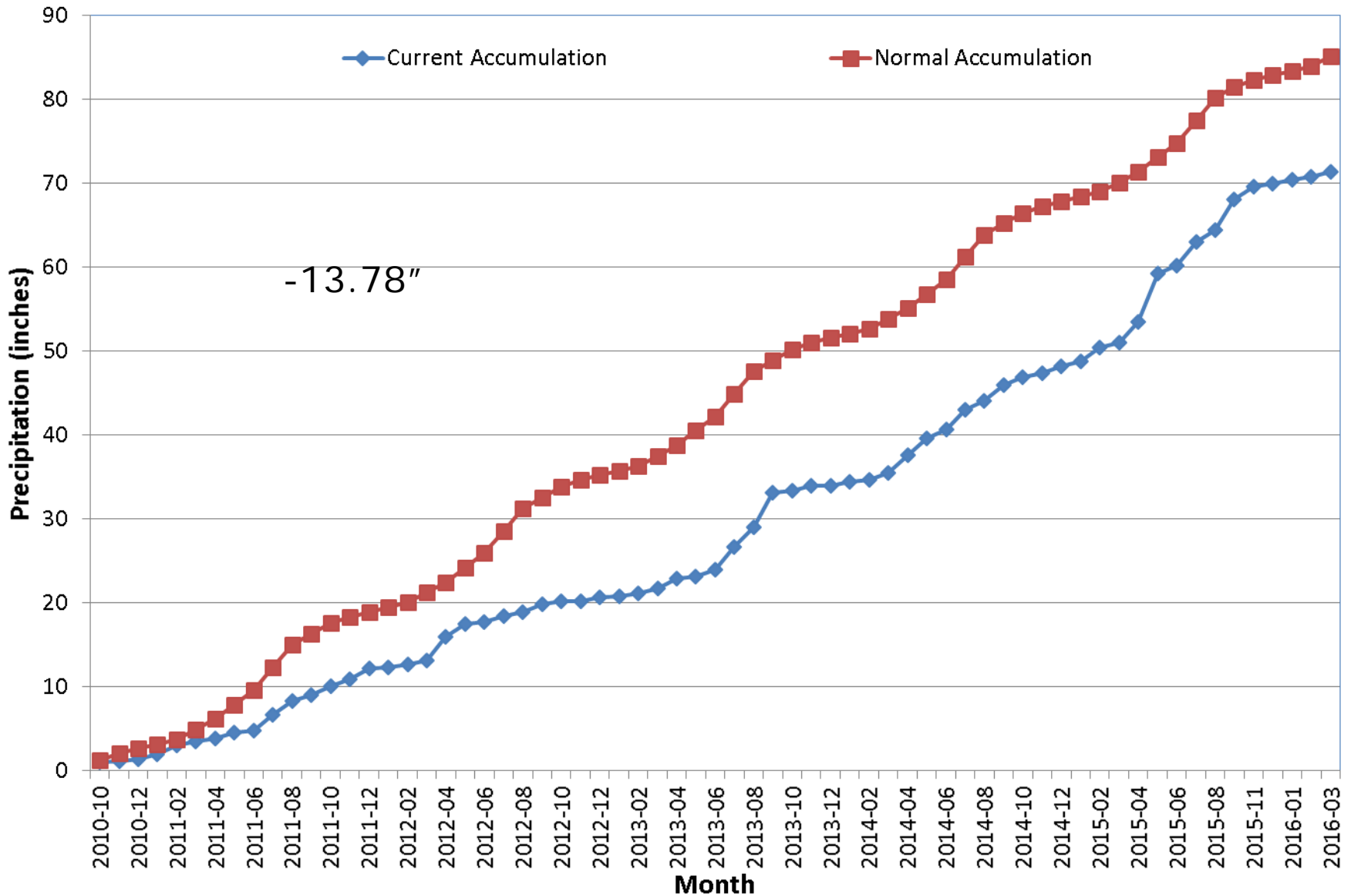
Lamar Monthly Accumulated Precipitation



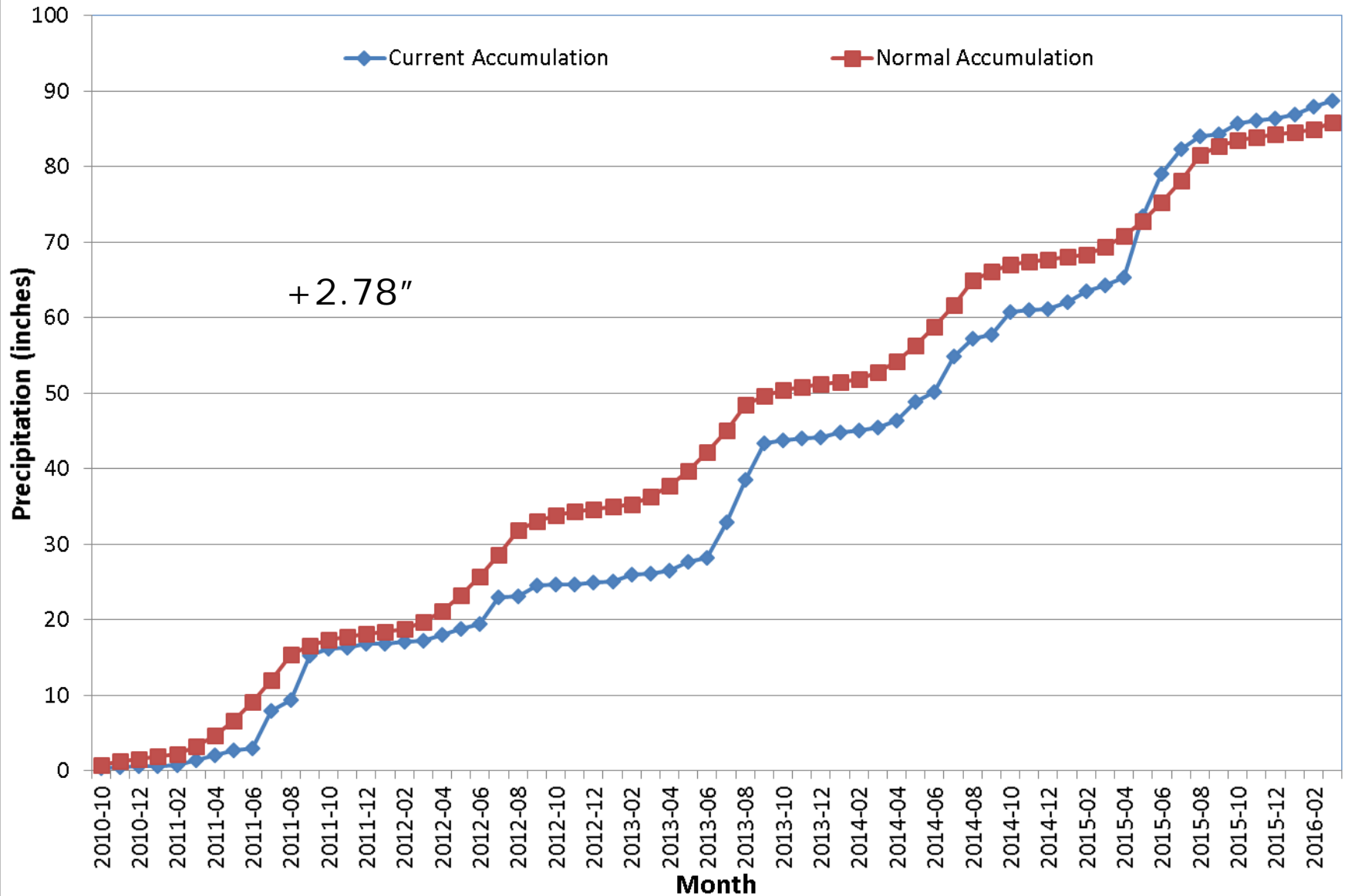
Rocky Ford Accumulated Precipitation



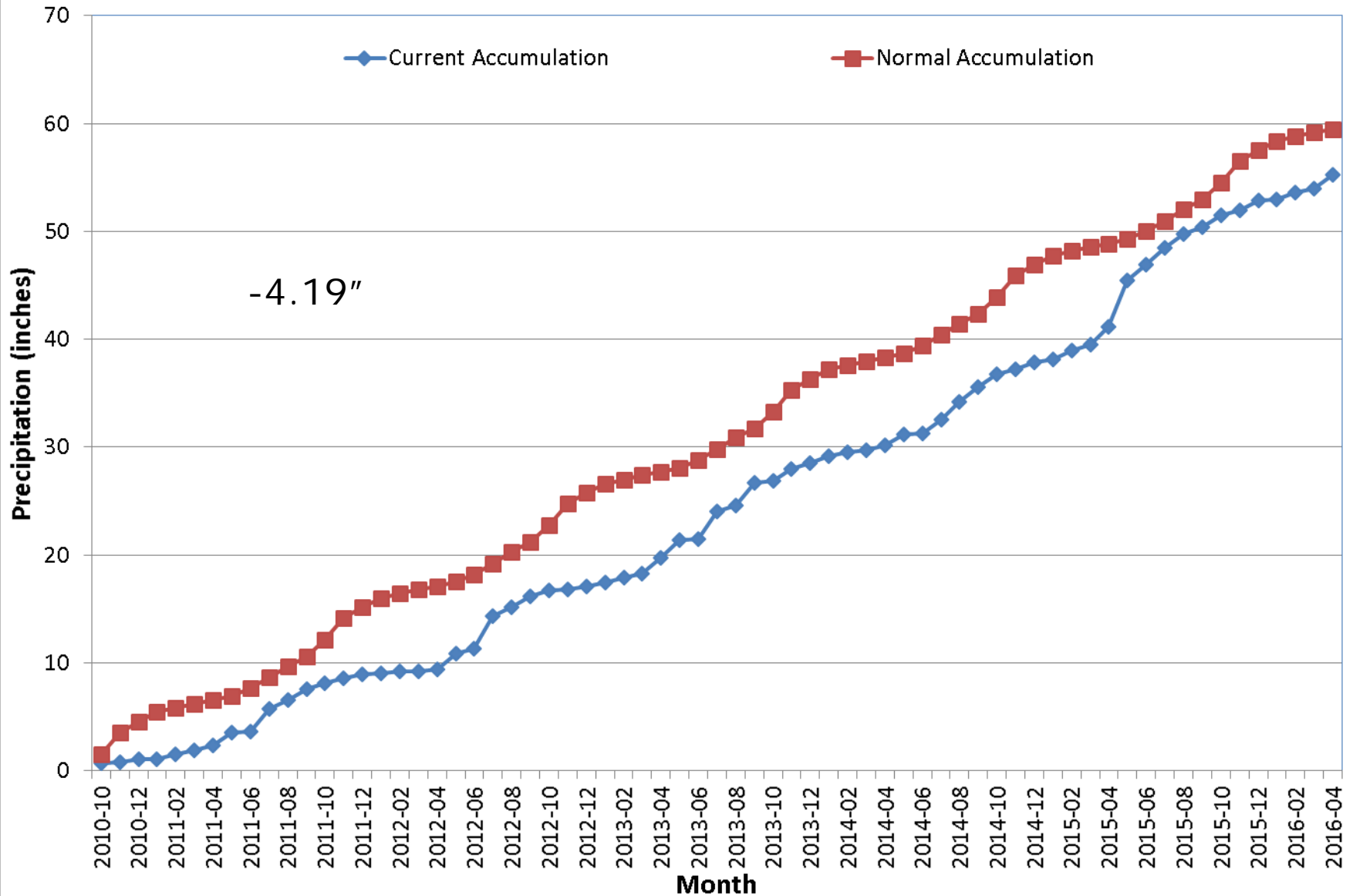
Trinidad Accumulated Precipitation



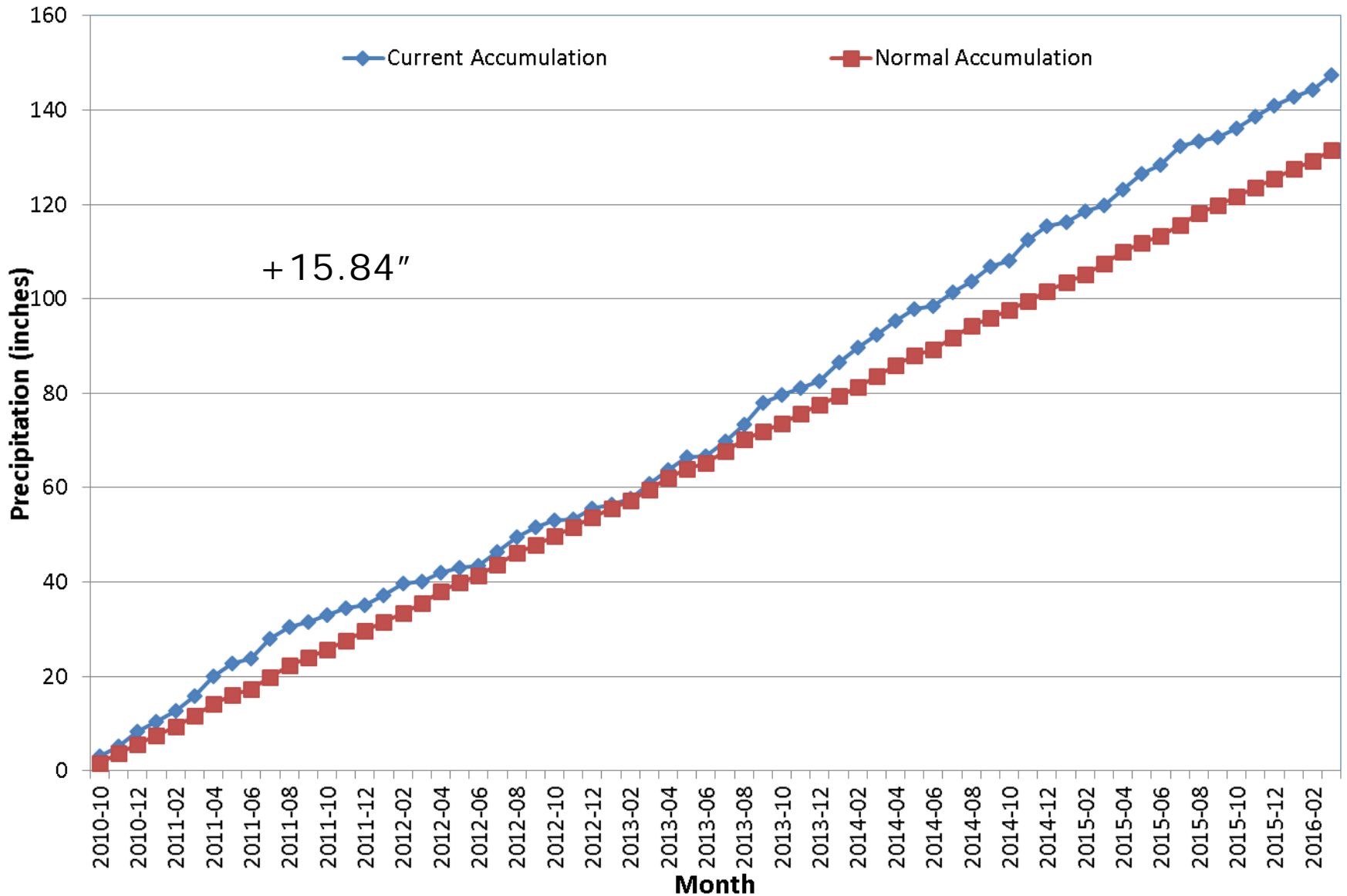
Colorado Springs AP Accumulated Precipitation



Buena Vista Accumulated Precipitation



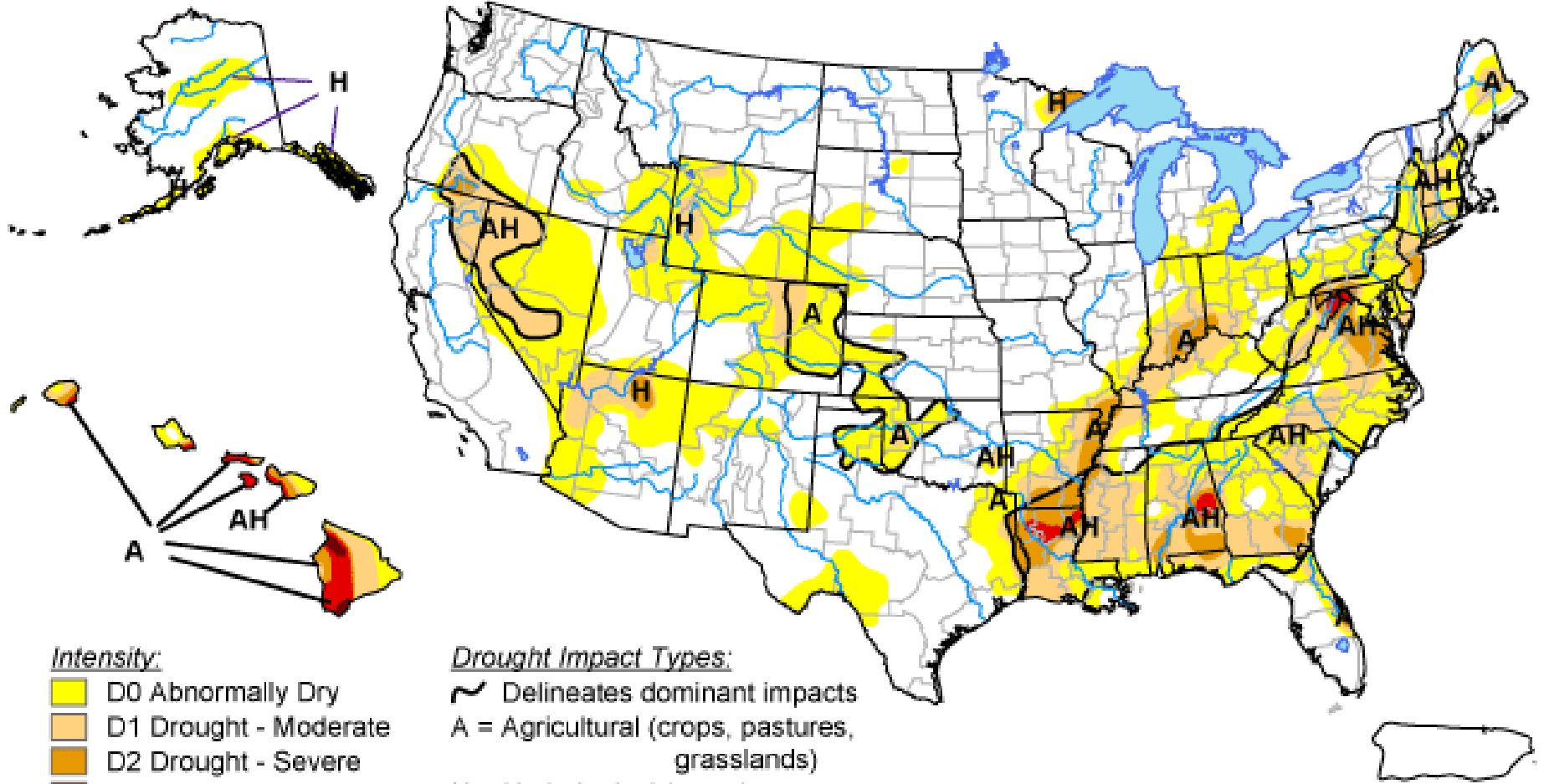
Climax Accumulated Precipitation








U.S. Drought Monitor

September 28, 2010


Valid 8 a.m. EDT



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



Released Thursday, September 30, 2010

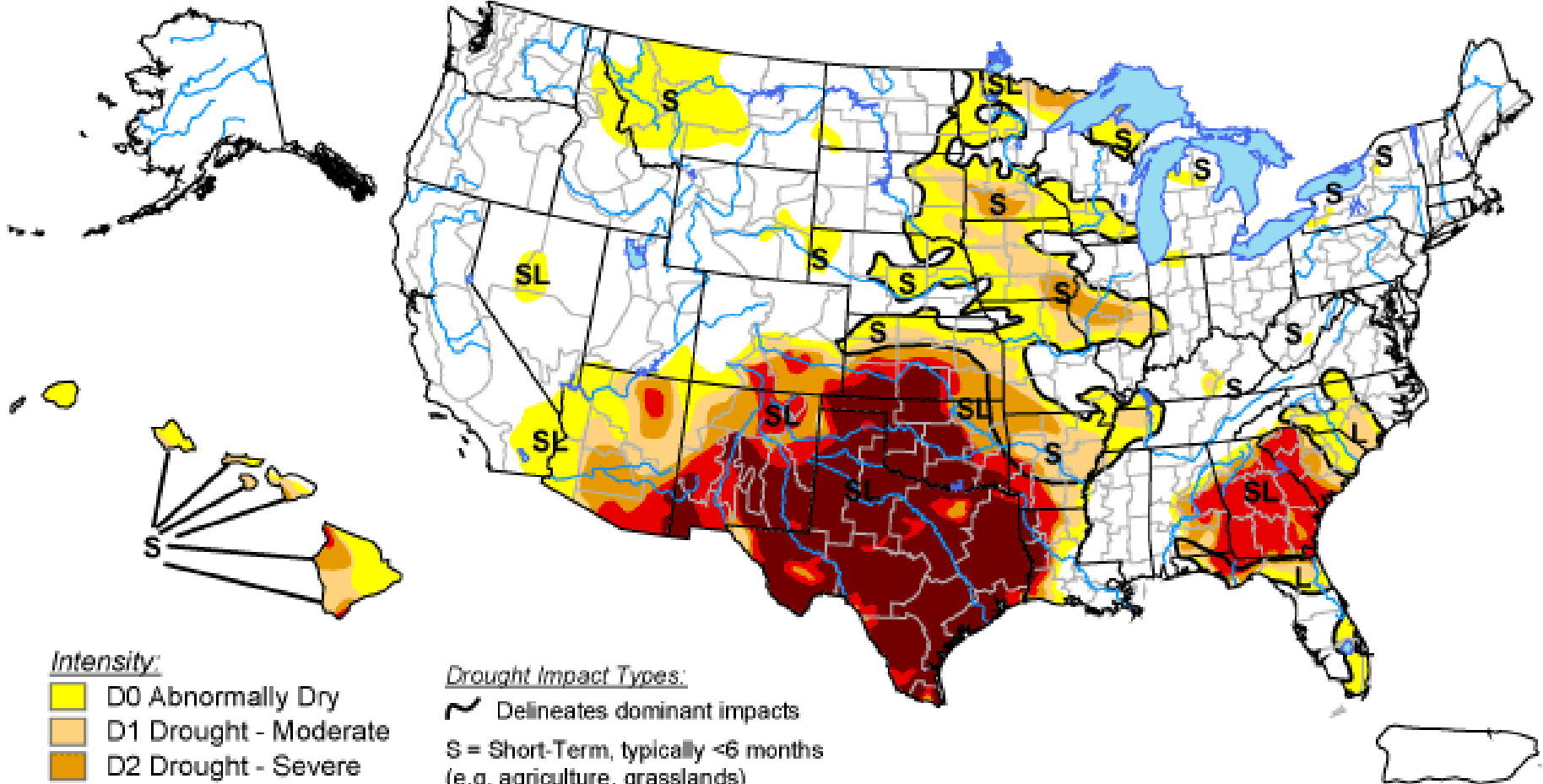
Author: Richard Heim/Liz Love-Brotak, NOAA/NESDIS/NCDC

<http://drought.unl.edu/dm>






U.S. Drought Monitor

October 4, 2011


Valid 8 a.m. EDT



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

Drought Impact Types:

-  Delineates dominant impacts
- S = Short-Term, typically <6 months
(e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months
(e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. See accompanying text summary
for forecast statements.



Released Thursday, October 6, 2011

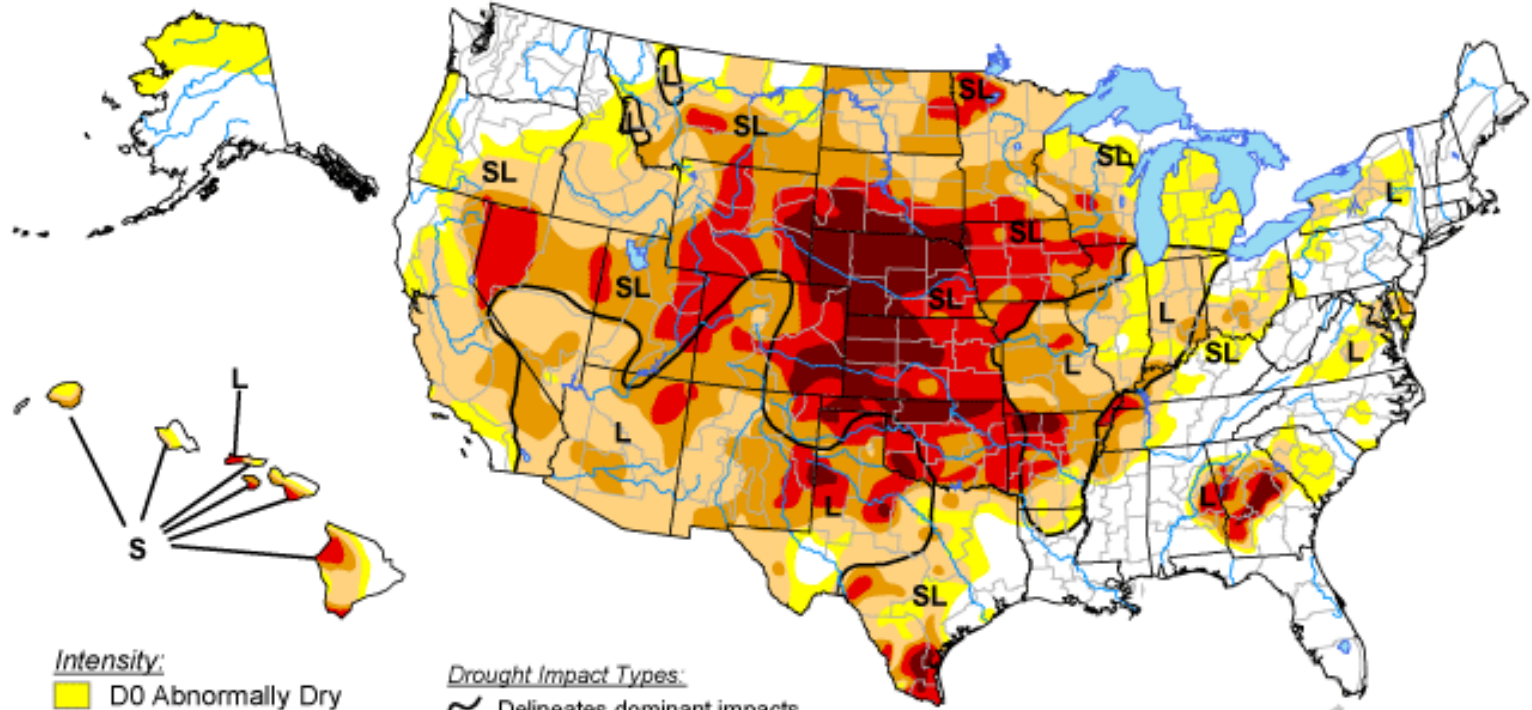
Author: Rich Tinker, CPC/NCEP/NWS/NOAA

<http://droughtmonitor.unl.edu/>






Drought Status at the end of 2012 Water Year

U.S. Drought Monitor


October 2, 2012
Valid 7 a.m. EDT



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

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<http://droughtmonitor.unl.edu/>

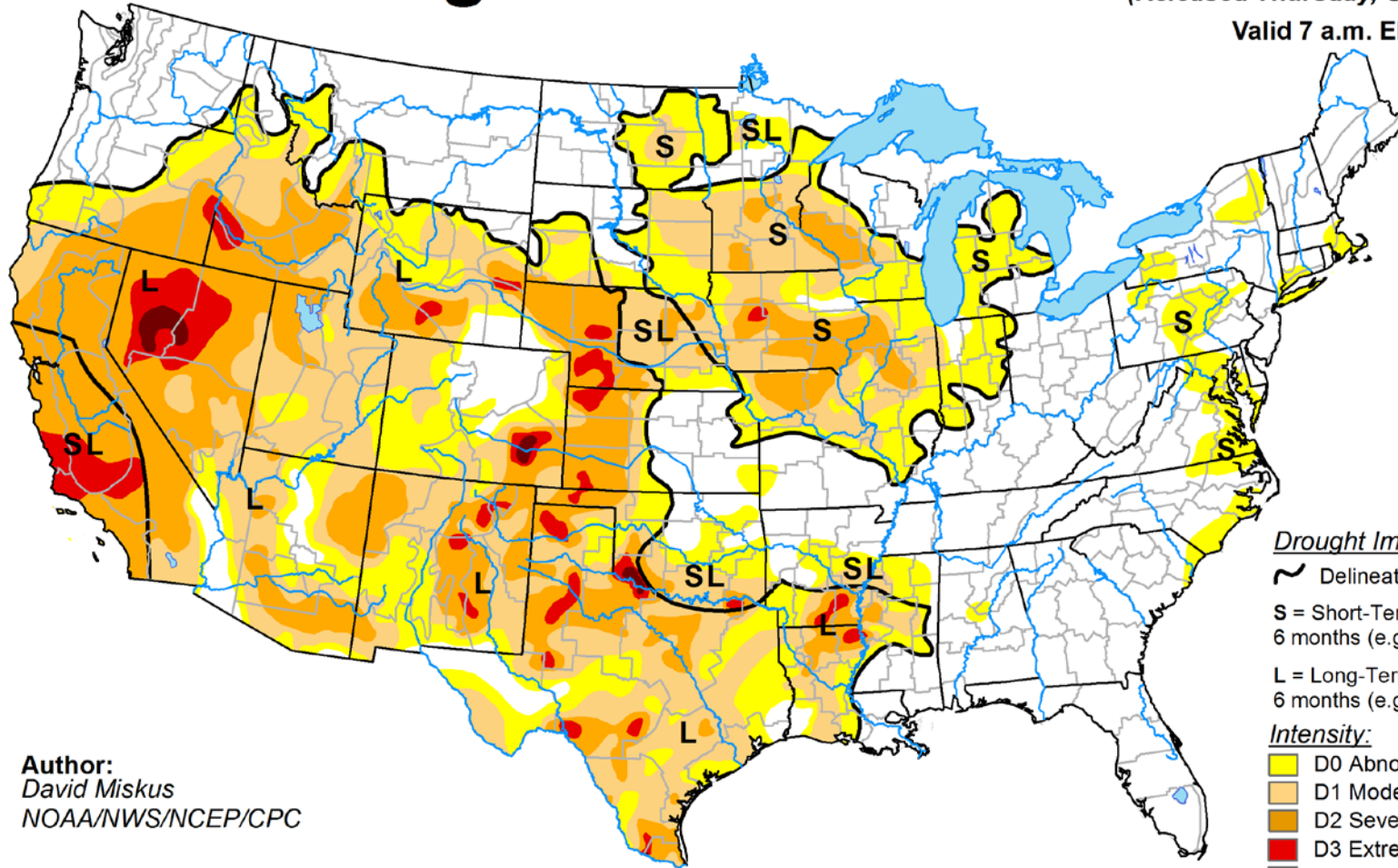


Released Thursday, October 4, 2012
Author: Anthony Artusa, NOAA/NWS/NCEP/CPC

U.S. Drought Monitor

October 1, 2013
(Released Thursday, Oct. 3, 2013)

Valid 7 a.m. EDT



Author:
David Miskus
NOAA/NWS/NCEP/CPC

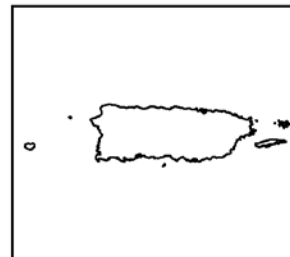
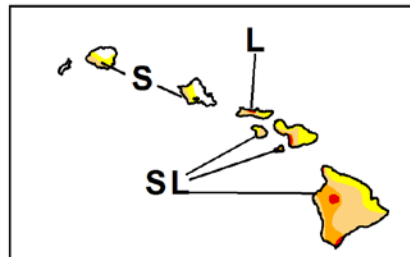
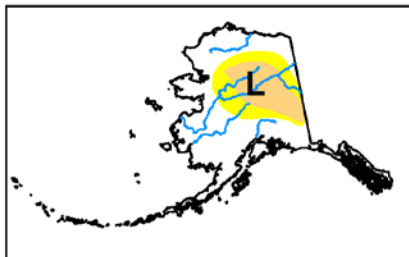
Drought Impact Types:

- ~ Delineates dominant impacts
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Intensity:

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- D3 Extreme Drought
- D4 Exceptional Drought

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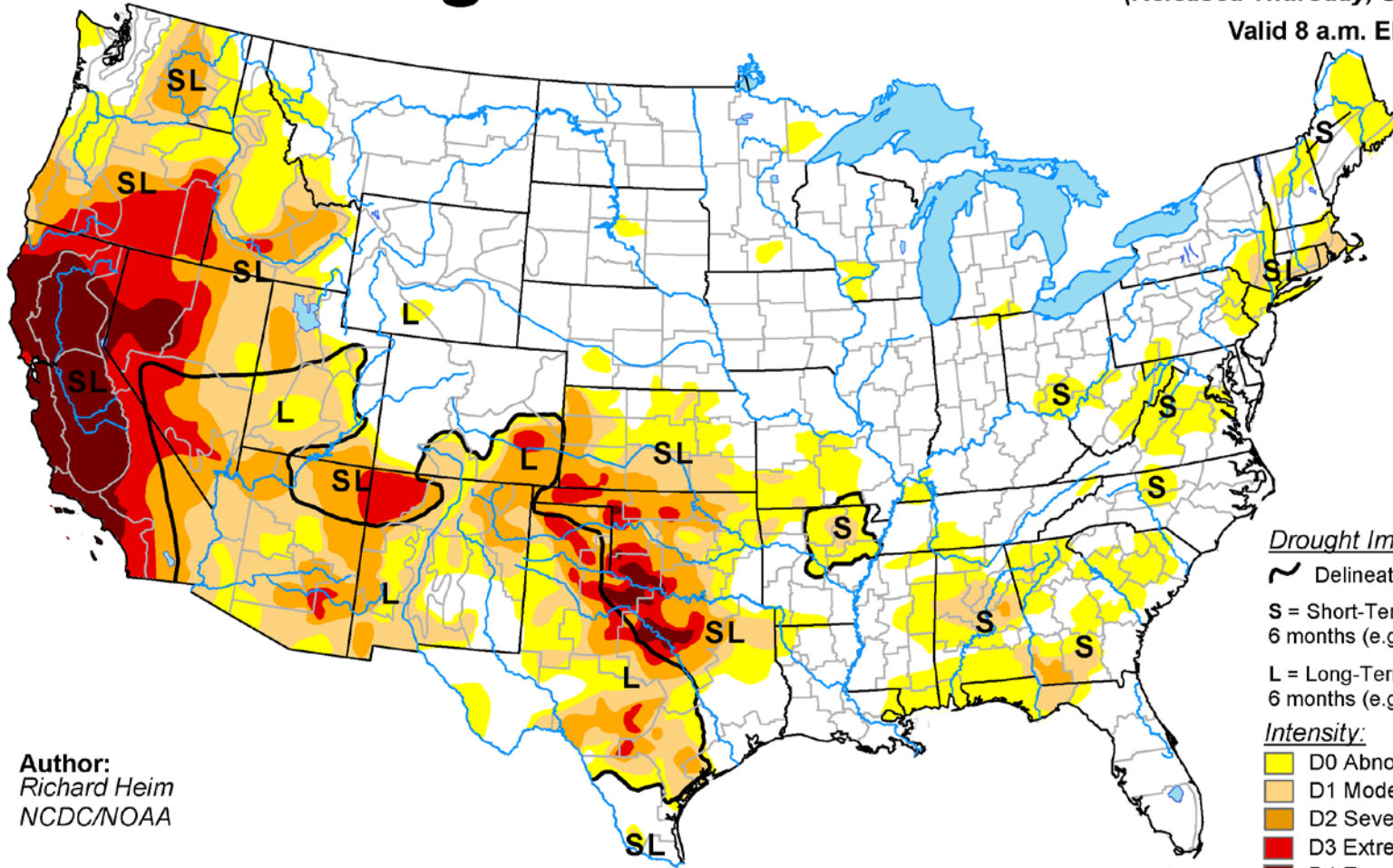
<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor

September 30, 2014

(Released Thursday, Oct. 2, 2014)

Valid 8 a.m. EDT



Author:
Richard Heim
NCDC/NOAA

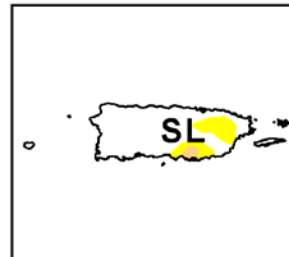
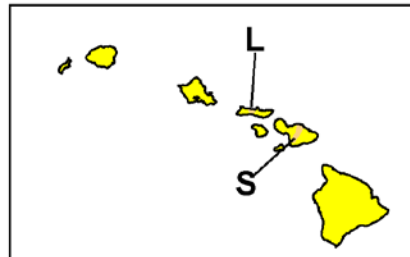
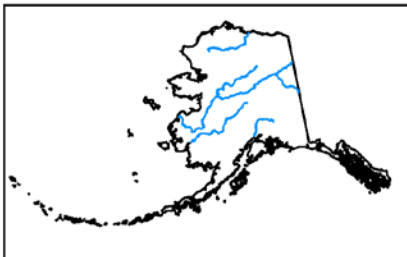
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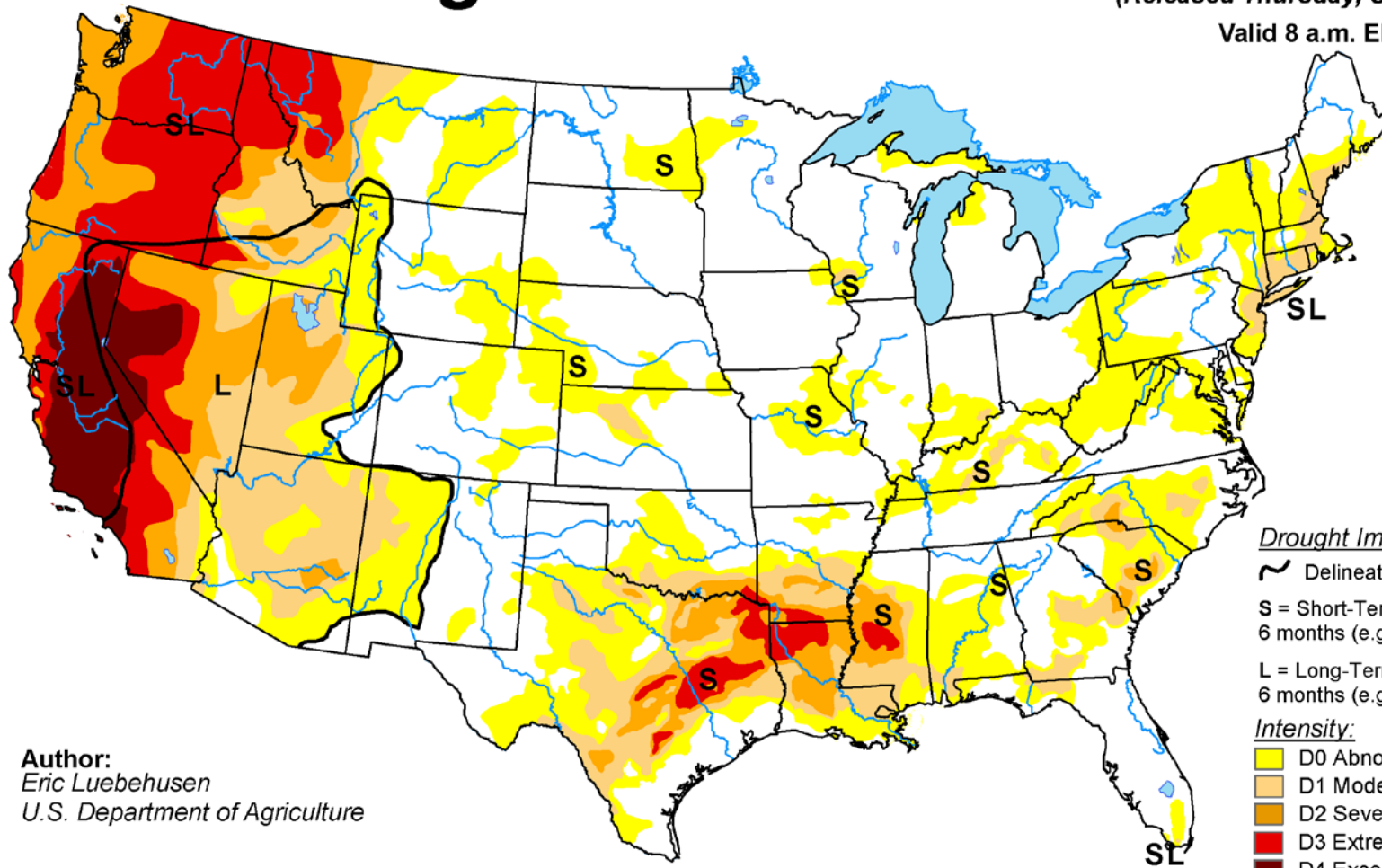
<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor

September 29, 2015


(Released Thursday, Oct. 1, 2015)

Valid 8 a.m. EDT








Author:
Eric Luebehusen
U.S. Department of Agriculture

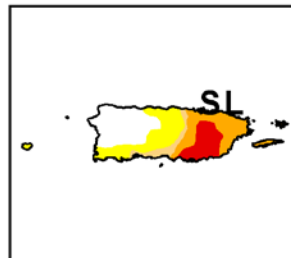
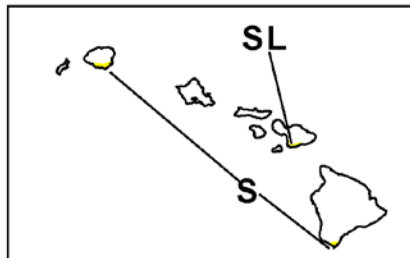
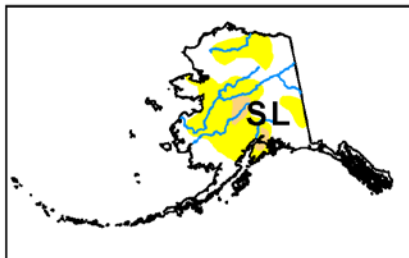
Drought Impact Types:

-  Delineates dominant impacts
- S** = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L** = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

-  D0 Abnormally Dry
-  D1 Moderate Drought
-  D2 Severe Drought
-  D3 Extreme Drought
-  D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



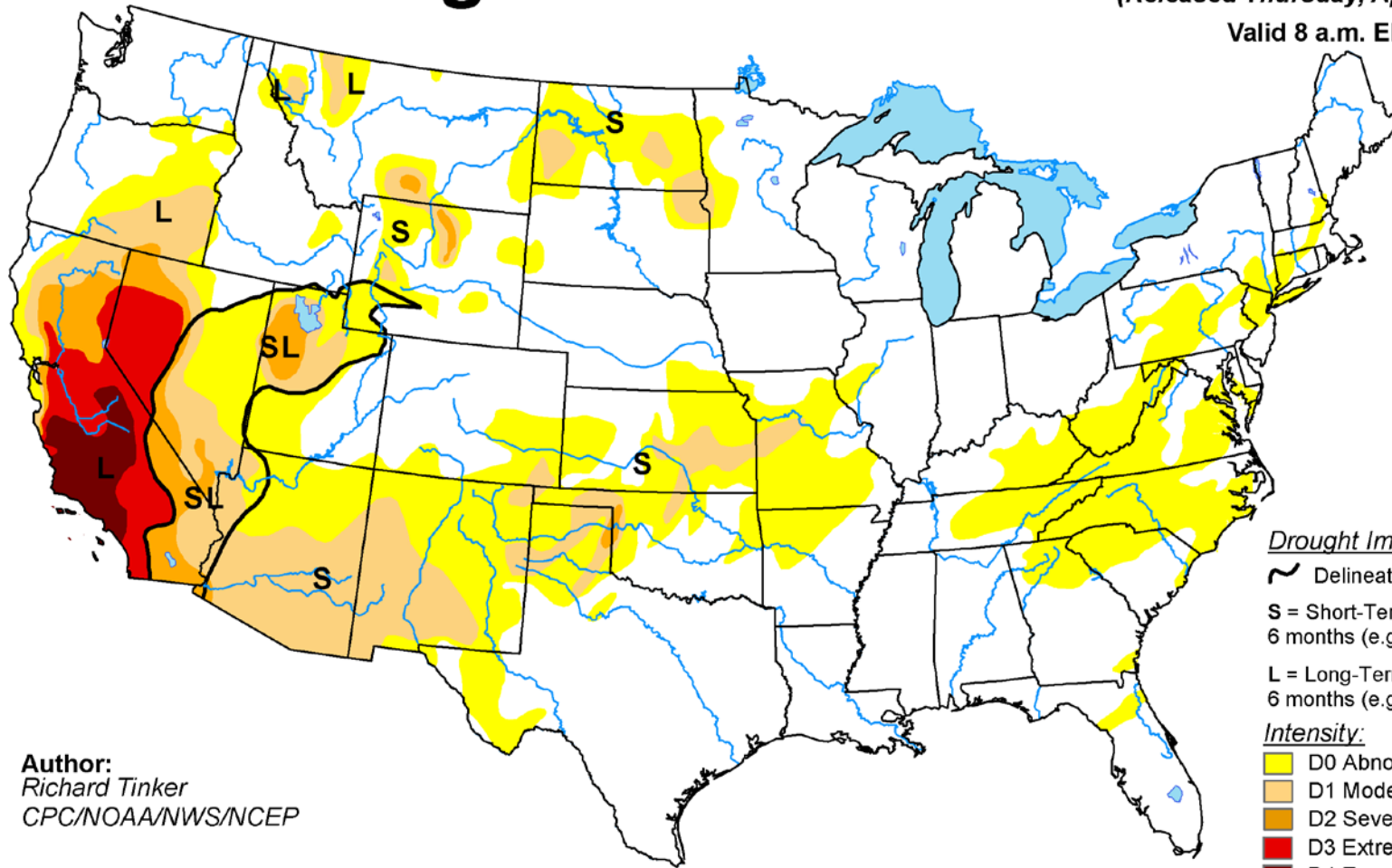
<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor

April 19, 2016

(Released Thursday, Apr. 21, 2016)

Valid 8 a.m. EDT



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

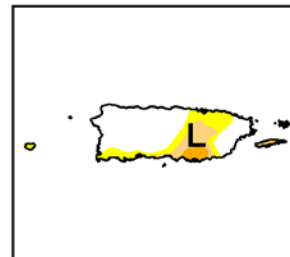
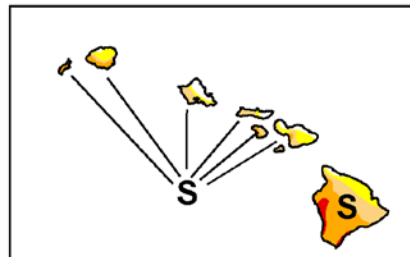
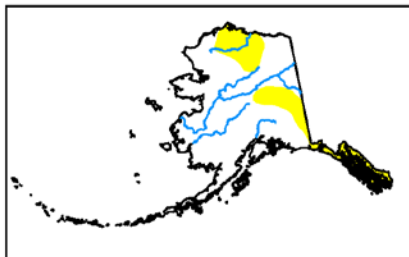
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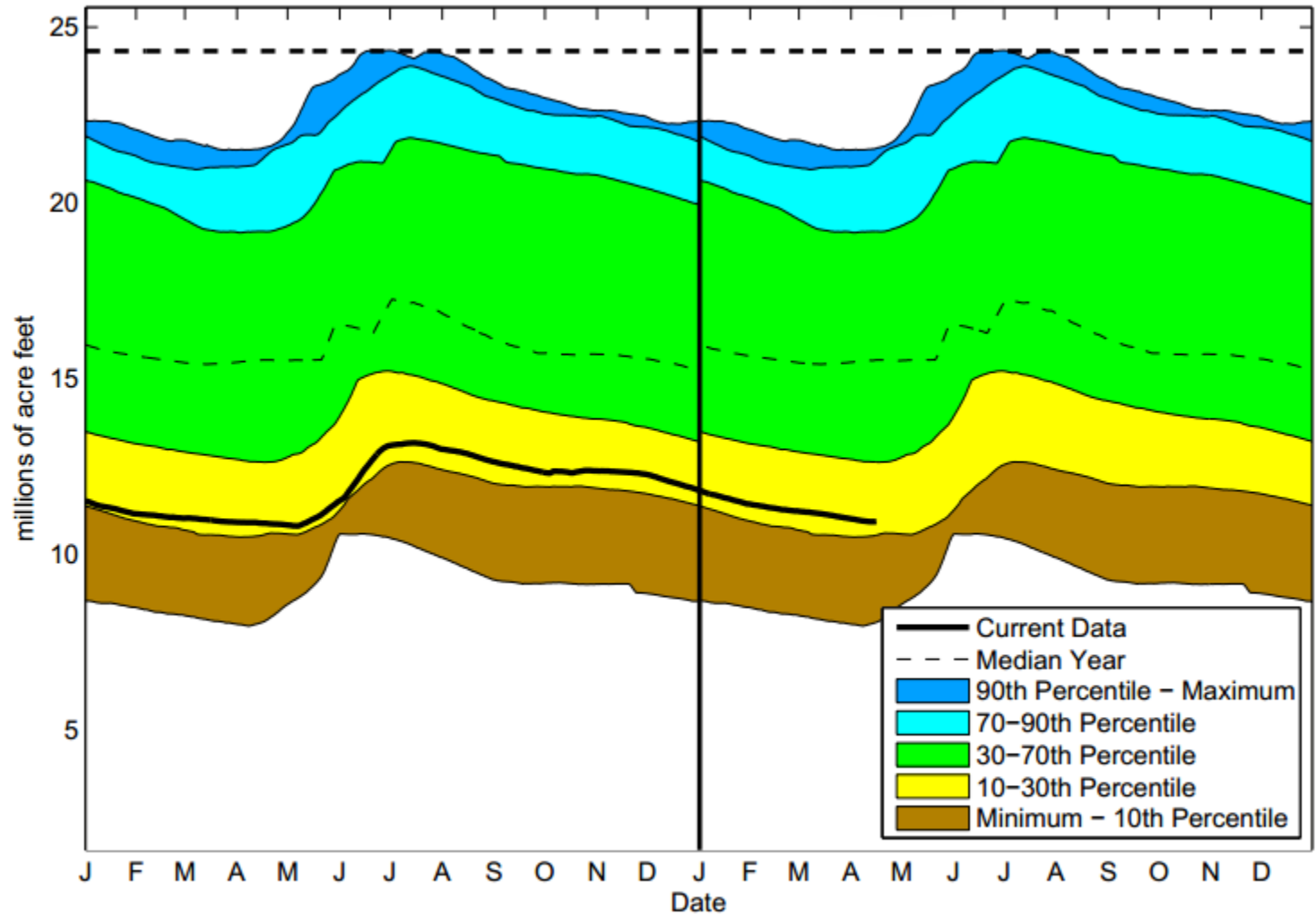
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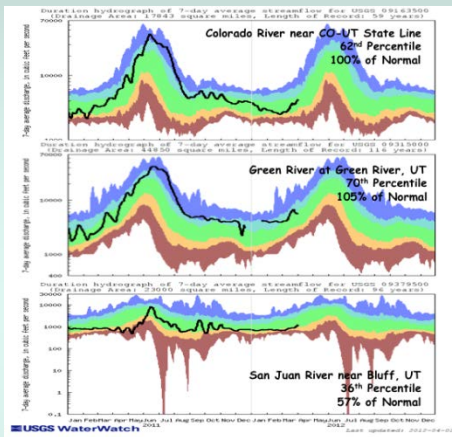
<http://droughtmonitor.unl.edu/>

Lake Powell

Lake Powell Reservoir Level 04/16/2016
70 Percent of 1985-2015 Average



Weekly Climate Updates Available Upper Colorado Regional Drought Early Warning

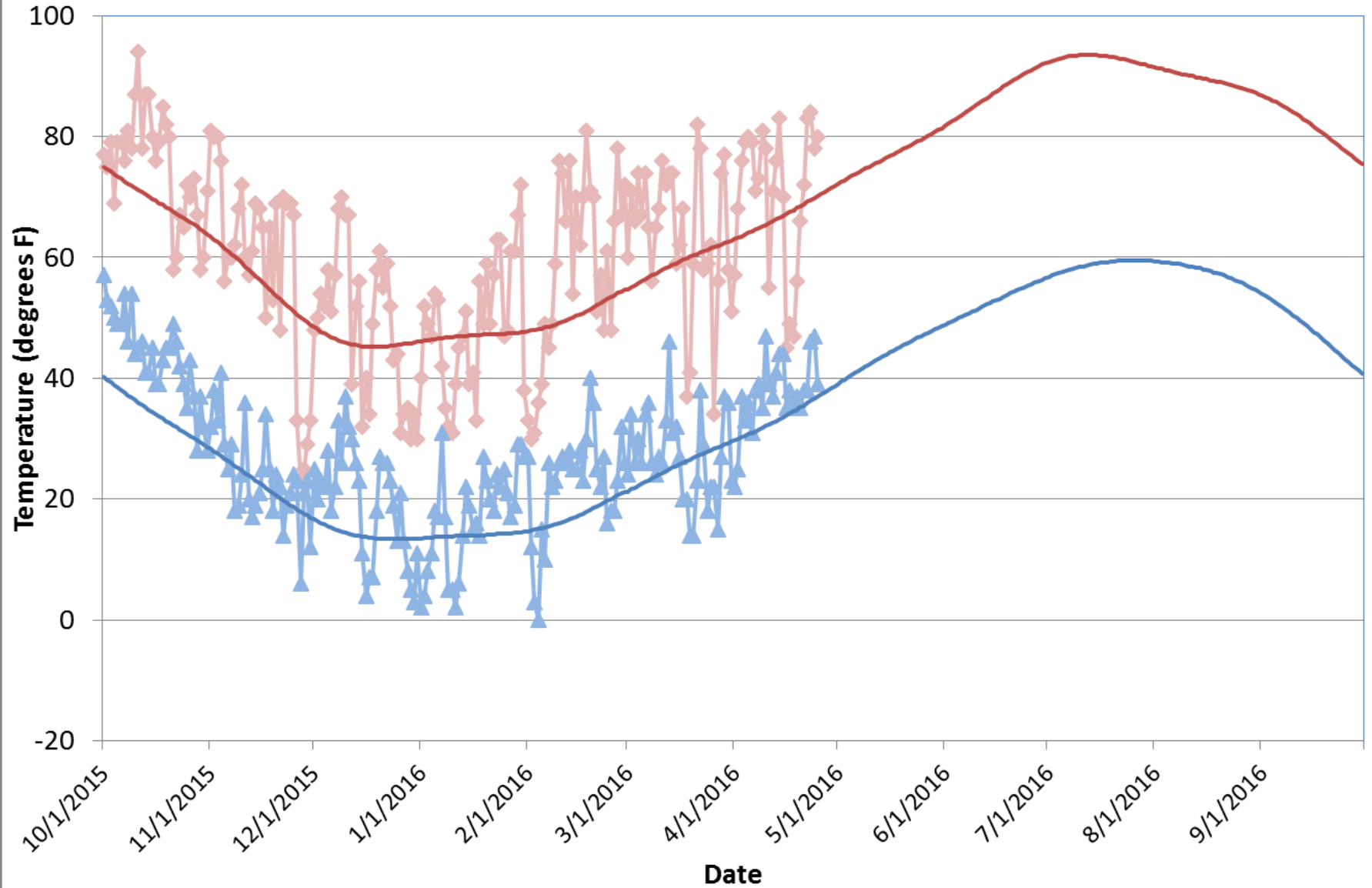


So, what about this winter?



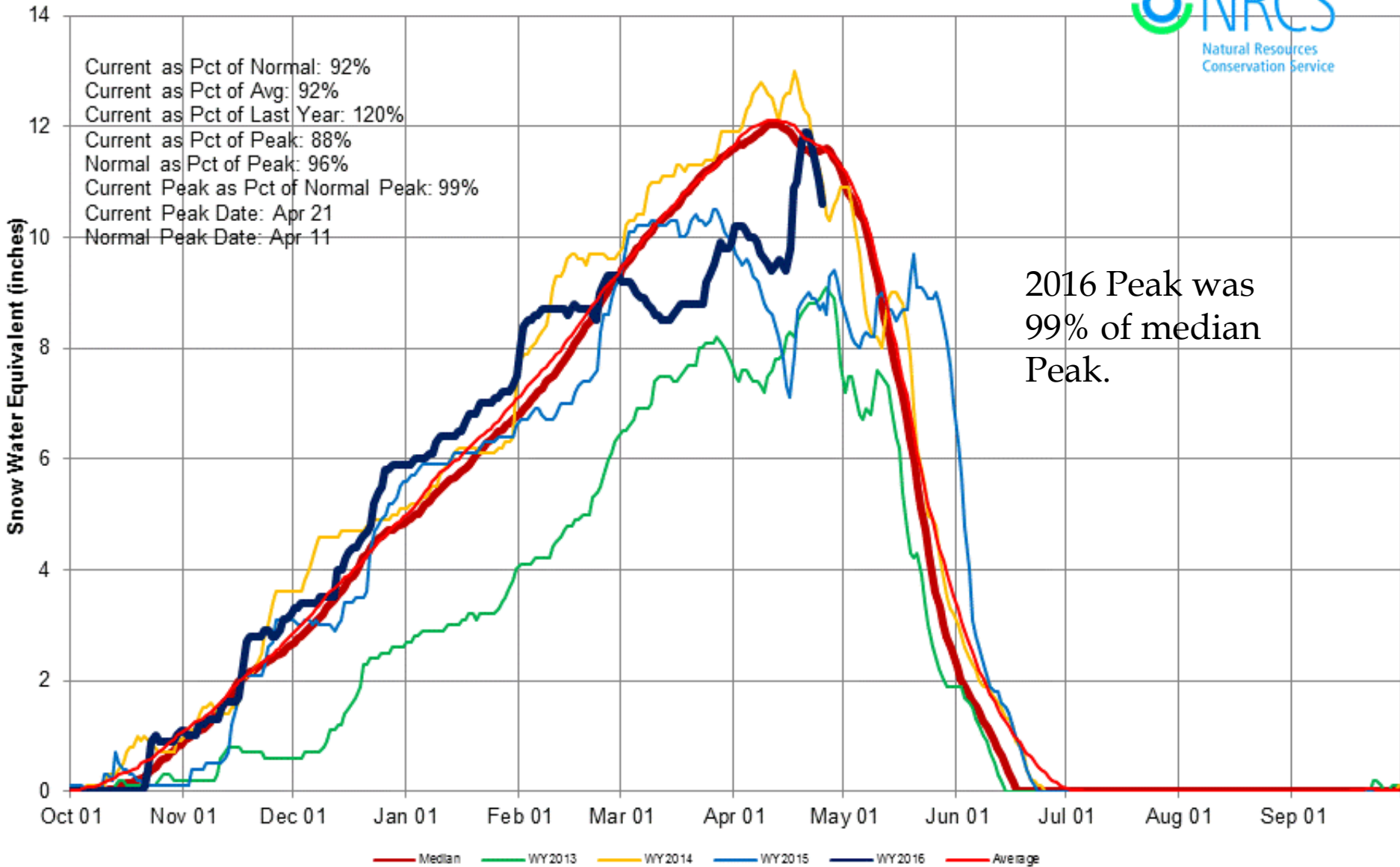
Pueblo Airport Daily Max/Min Temperature and Normal for Water Year 2016

Max Temperature Normal Max Temperature Min Temperature Normal Min Temperature

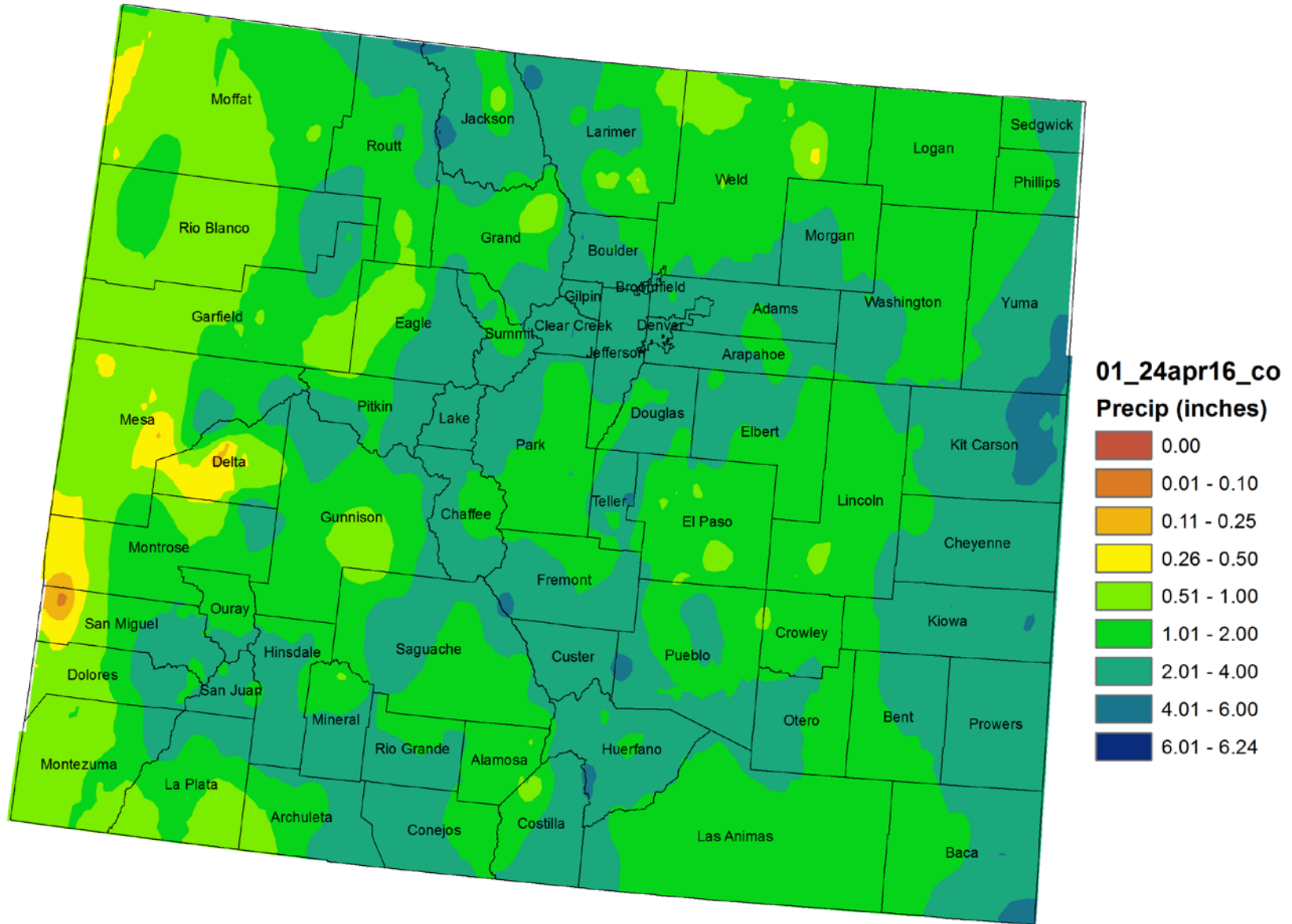


Arkansas River Basin Time Series Snowpack Summary

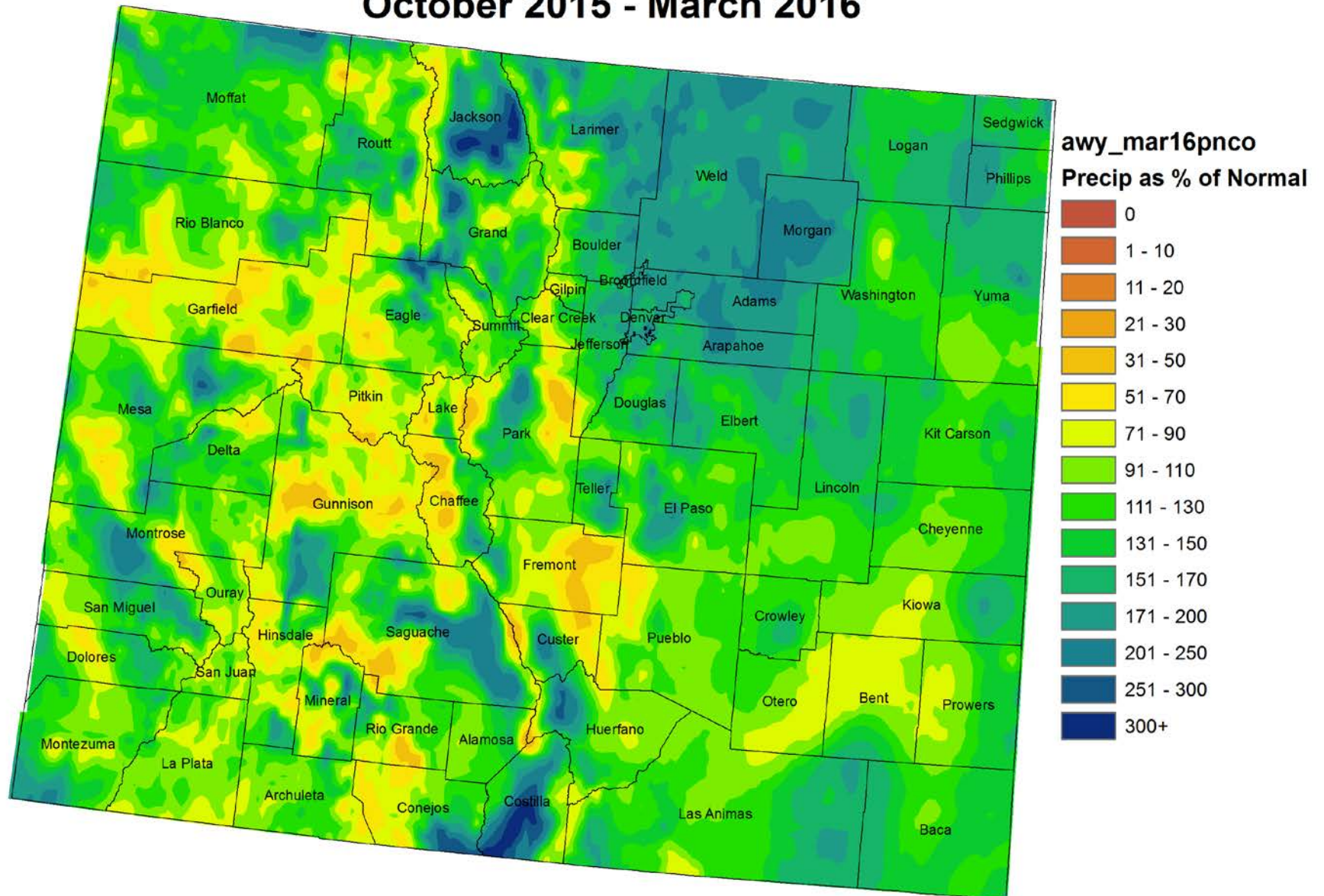
Based on Provisional SNOTEL data as of Apr 25, 2016



Colorado Month to Date Precipitation 1 - 24 April 2016



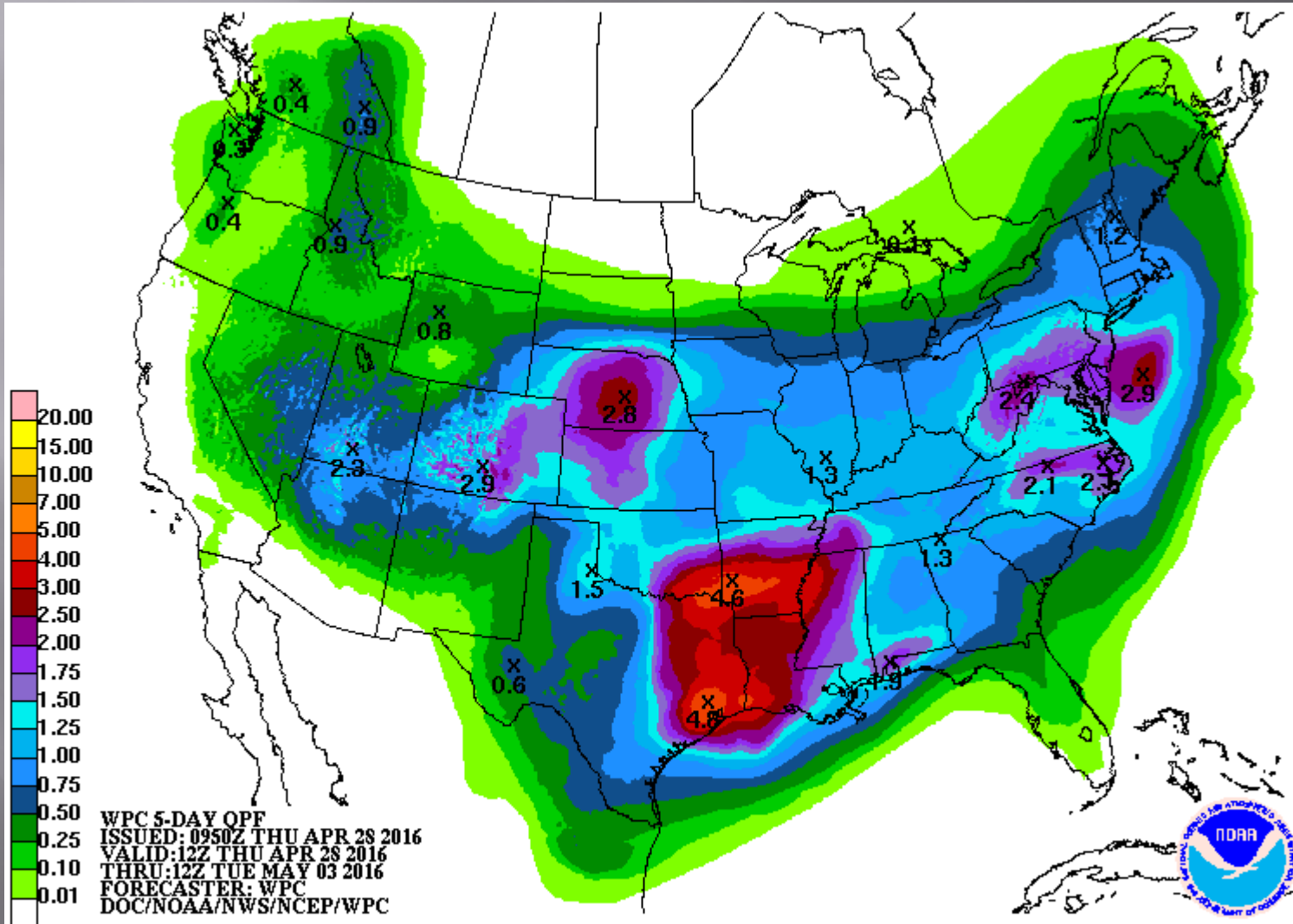
Colorado Water Year 2016 Precipitation as a Percentage of Normal October 2015 - March 2016



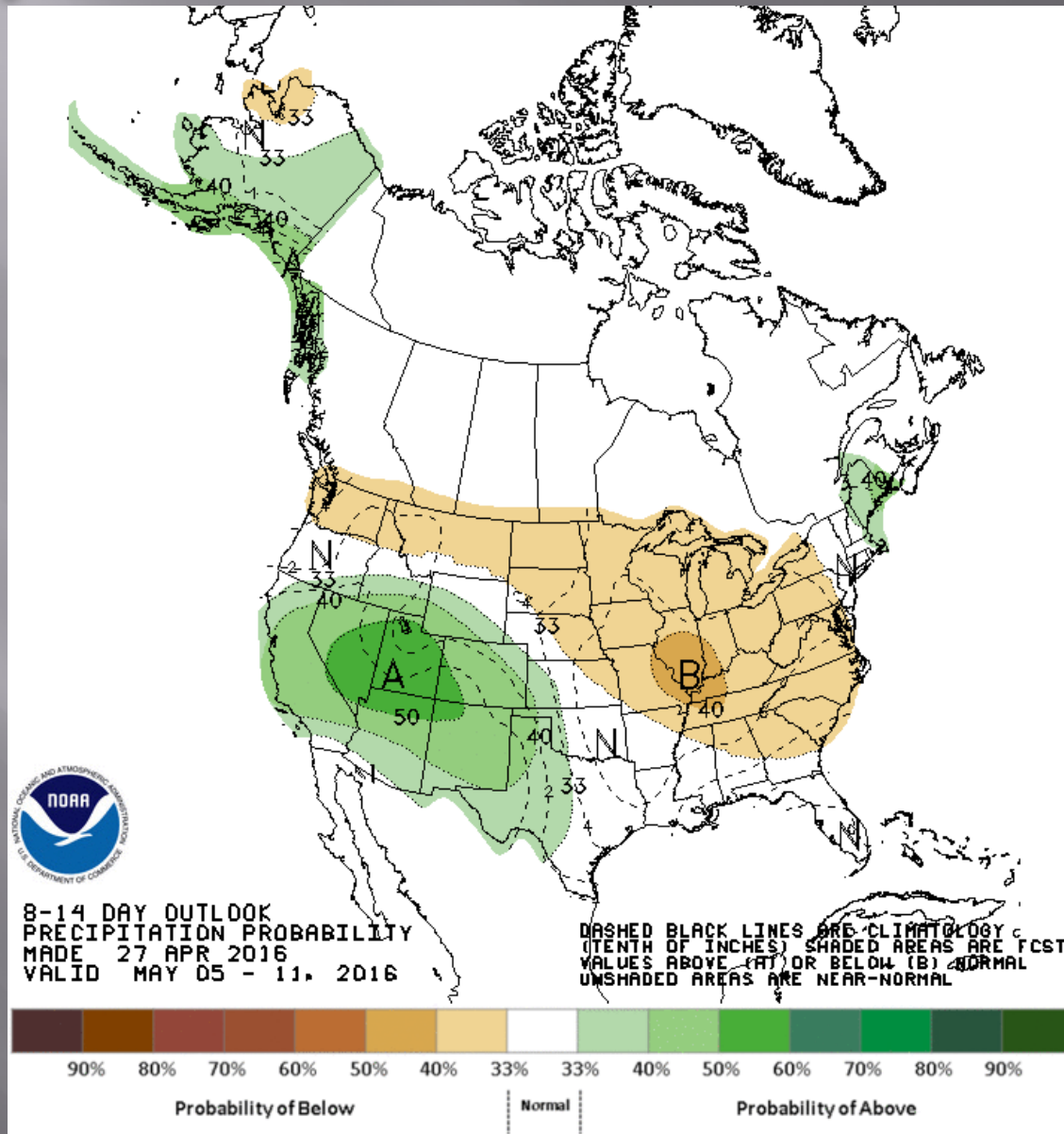
What Comes Next for Colorado?

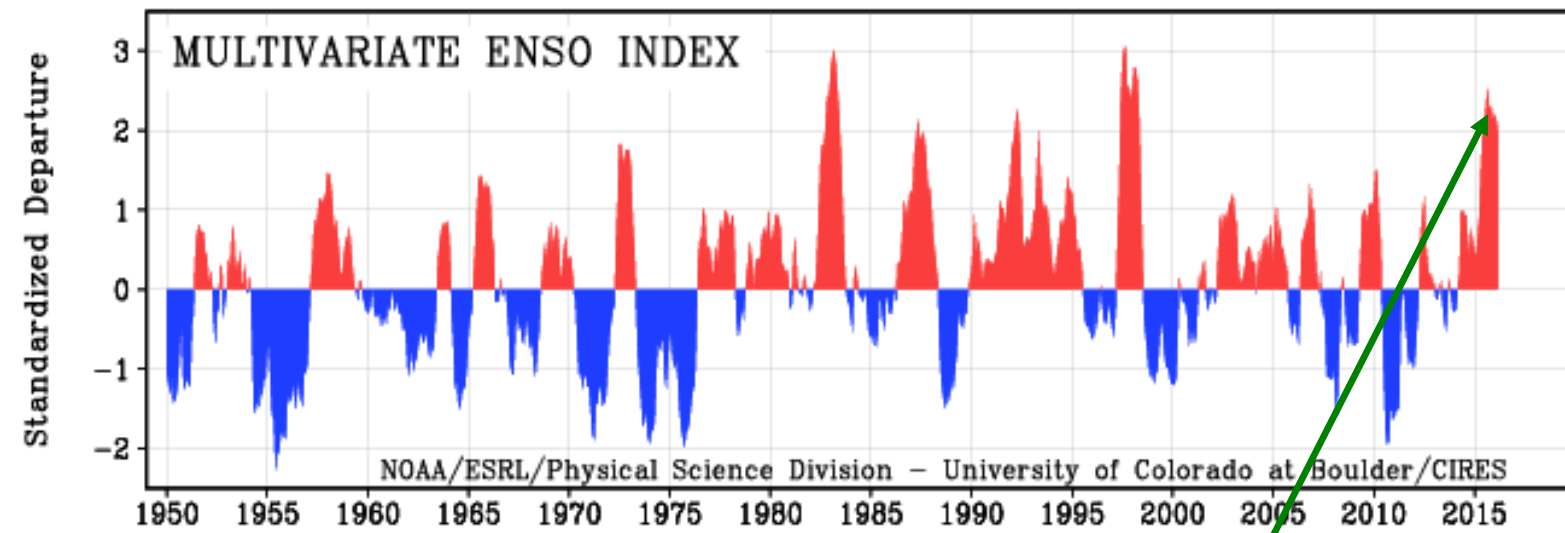


Cool and wet next few days!

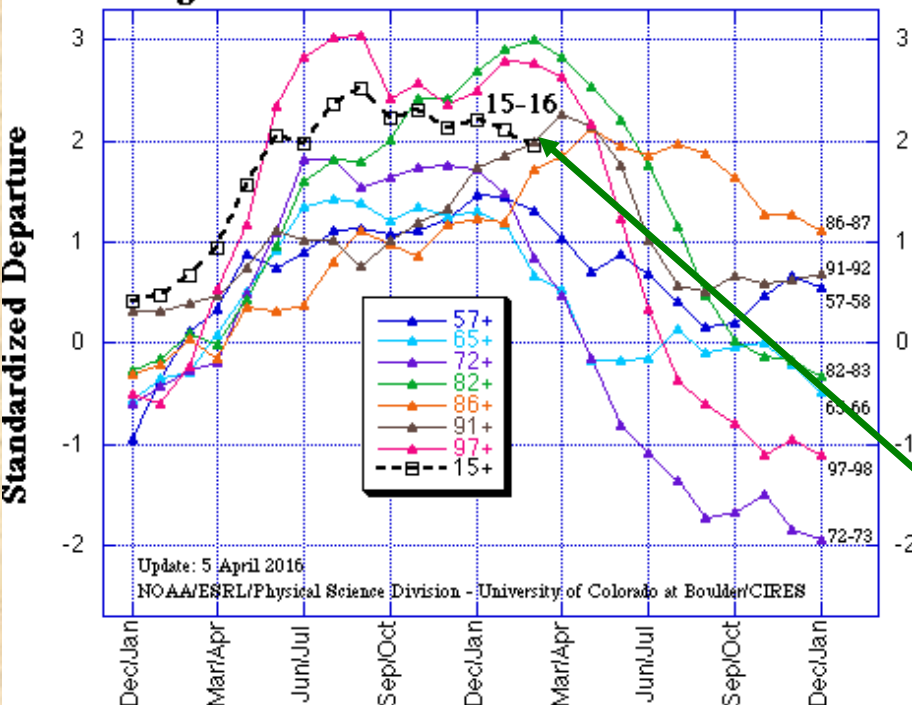


Maybe wet for Mother's Day?





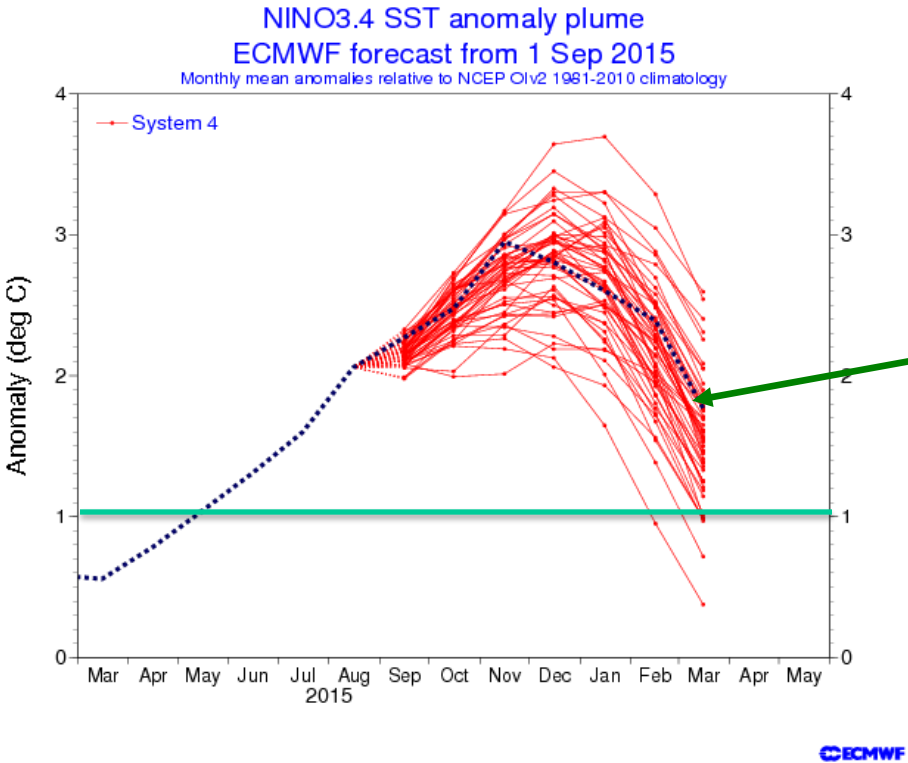
Multivariate ENSO Index (MEI) for the seven strongest El Niño events since 1950 vs. 2015-16



The **MEI** monitors ENSO based on all observed fields over the tropical Pacific (pressure, wind, temperatures, cloudiness). It is the 1st combined Principal Component, normalized with respect to the season. **The current El Niño peaked in Aug/Sep at +2.53, the largest MEI value since 1998.** The February-March update has dropped to 4th rank for the first time in nine months.

<http://www.esrl.noaa.gov/psd/enso/mei>

**El Nino is collapsing
but that's not necessarily
bad**

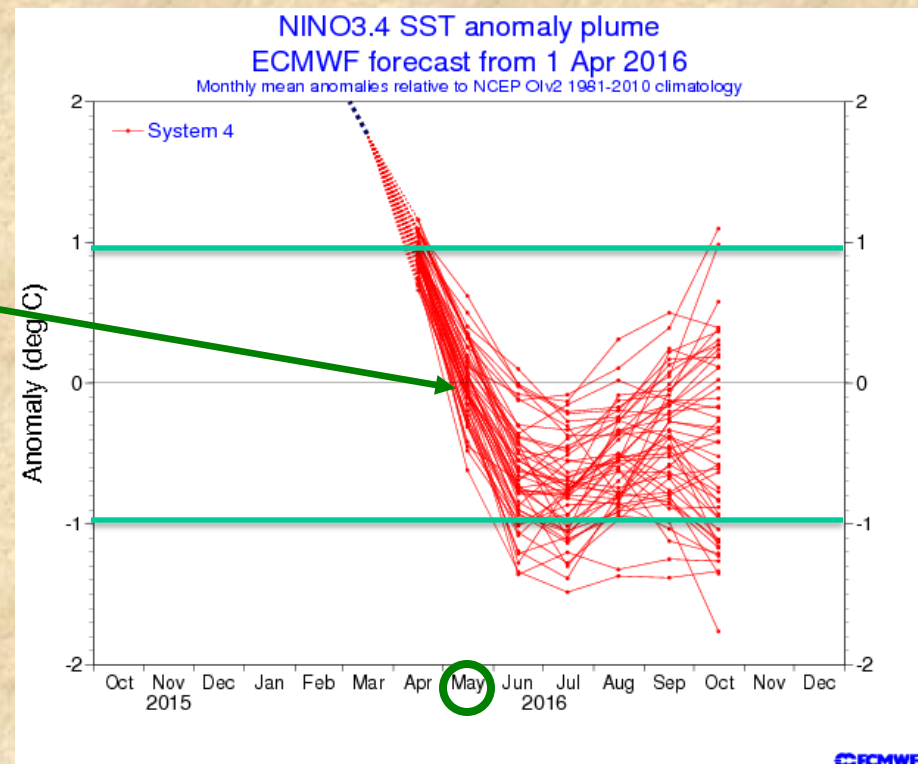


The ECMWF September 2015 forecast (left) showed a fairly compact plume, with a peak perhaps close to +3C which verified nicely a bit early (in November). While the observed trace (in stippled blue) was a bit higher than the median expectation, this was a very successful forecast thru March 2016.

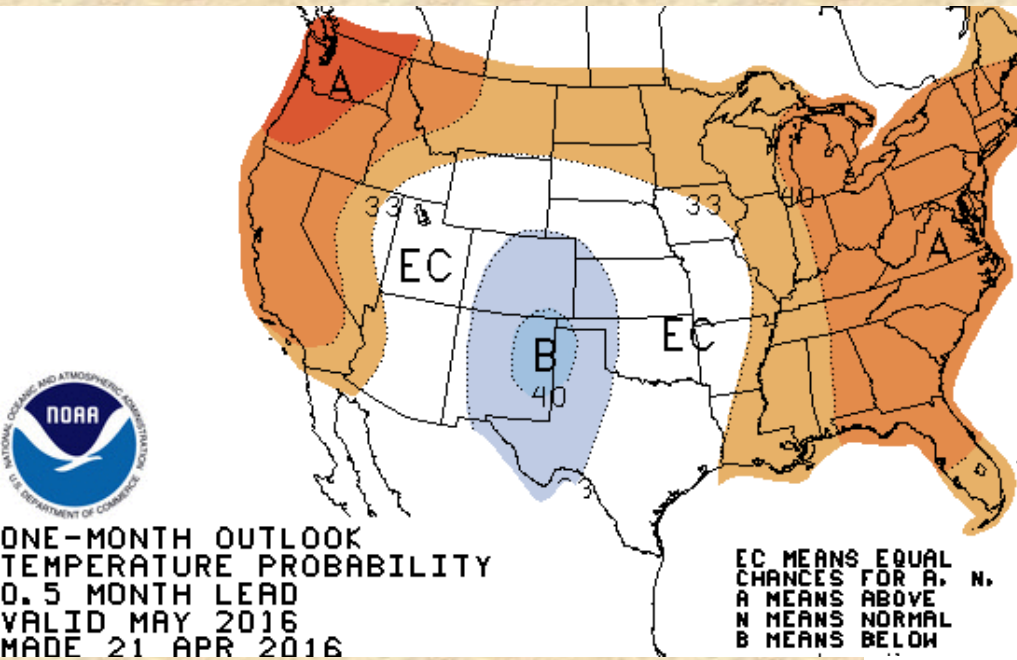
http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast/seasonal_range_forecast/

The latest ECMWF forecast (right) shows a swift decline of our El Niño to neutral status by May, a brief dip into La Niña (-0.5C) conditions during boreal summer, and a relaxation towards neutral afterwards.

It is perhaps noteworthy that the PDO hit +2.4 in March, very close to a record high. That record was set in 1941, right in the middle of a multi-Niño event ('39-'42). Bears watching!

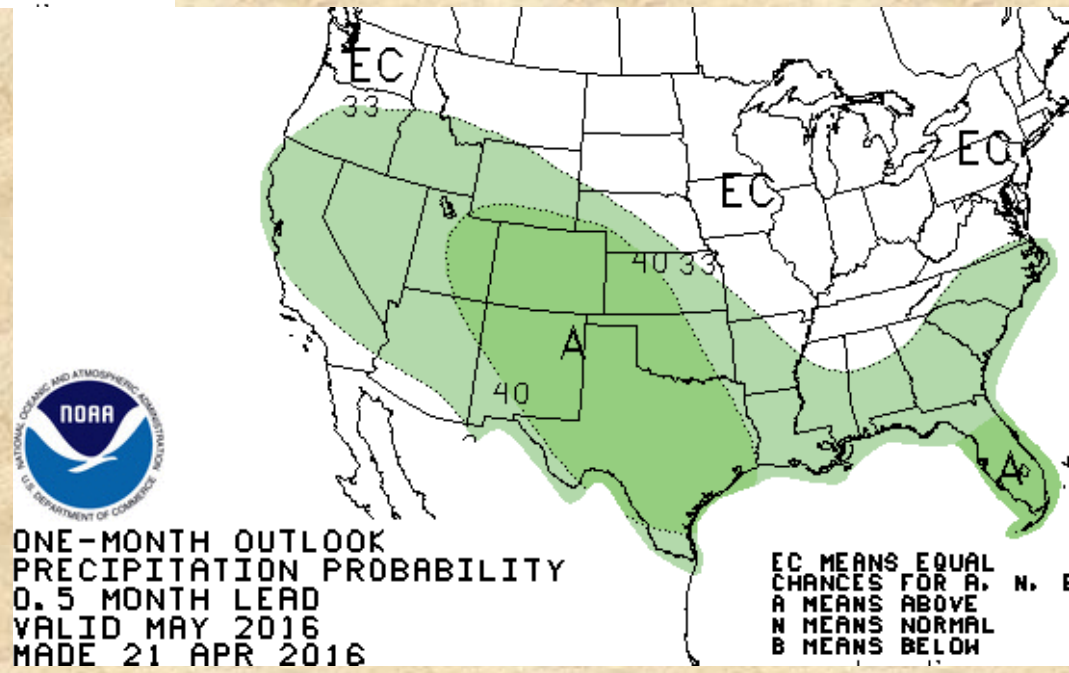


Climate Prediction Center Forecasts: May

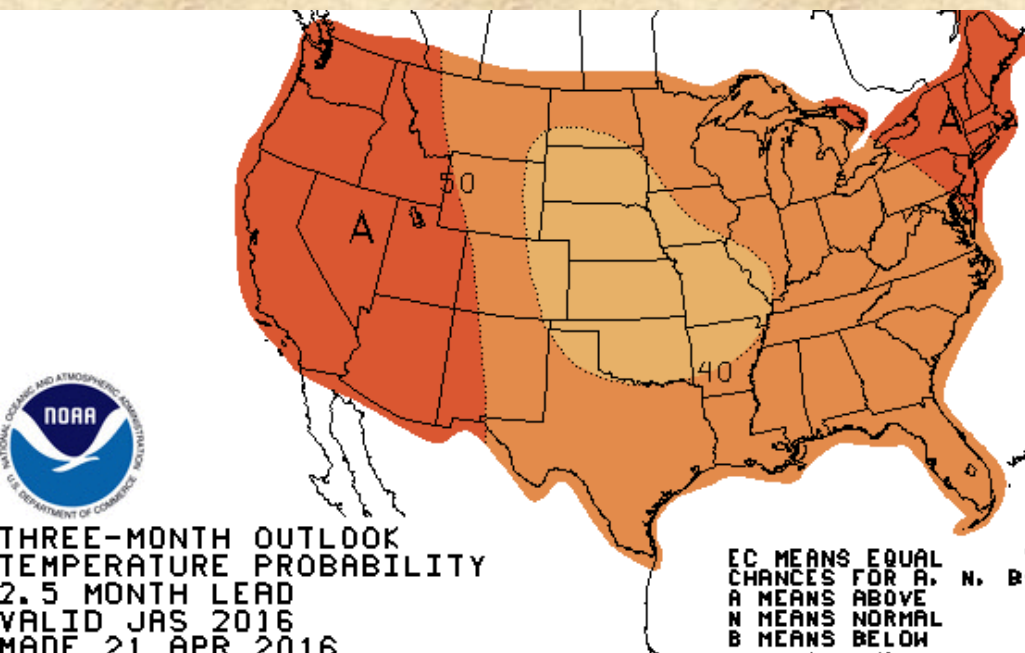


The CPC May temperature forecast (top left) is fairly cold for our state, while the precipitation forecast is wet which is consistent with that, especially east of the divide (right) – *June's forecast will look more muted than that...*

<http://www.cpc.ncep.noaa.gov/products/predictions/>



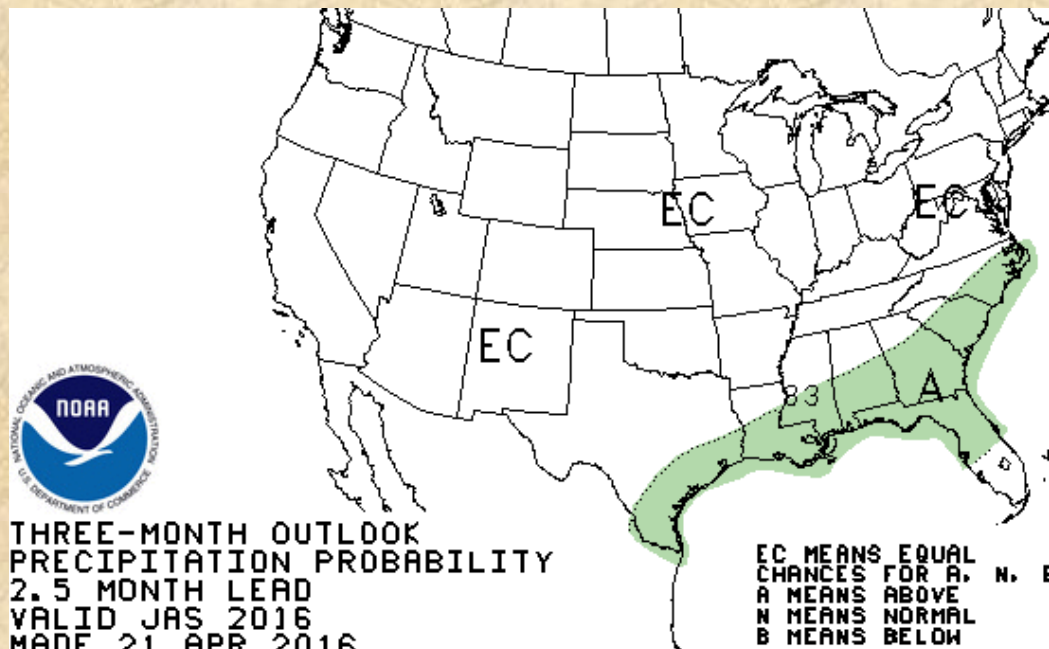
Climate Prediction Center Forecasts: JAS



**Expect a hot
summer with
some scattered
storms**

The CPC late summer temperature forecast (top left) is warmer than normal EVERYWHERE, least from eastern CO eastward to Georgia. The precipitation forecast is 'EC' for us (right) – they also did not buy into a rapid onset of La Niña.

<http://www.cpc.ncep.noaa.gov/products/predictions/>

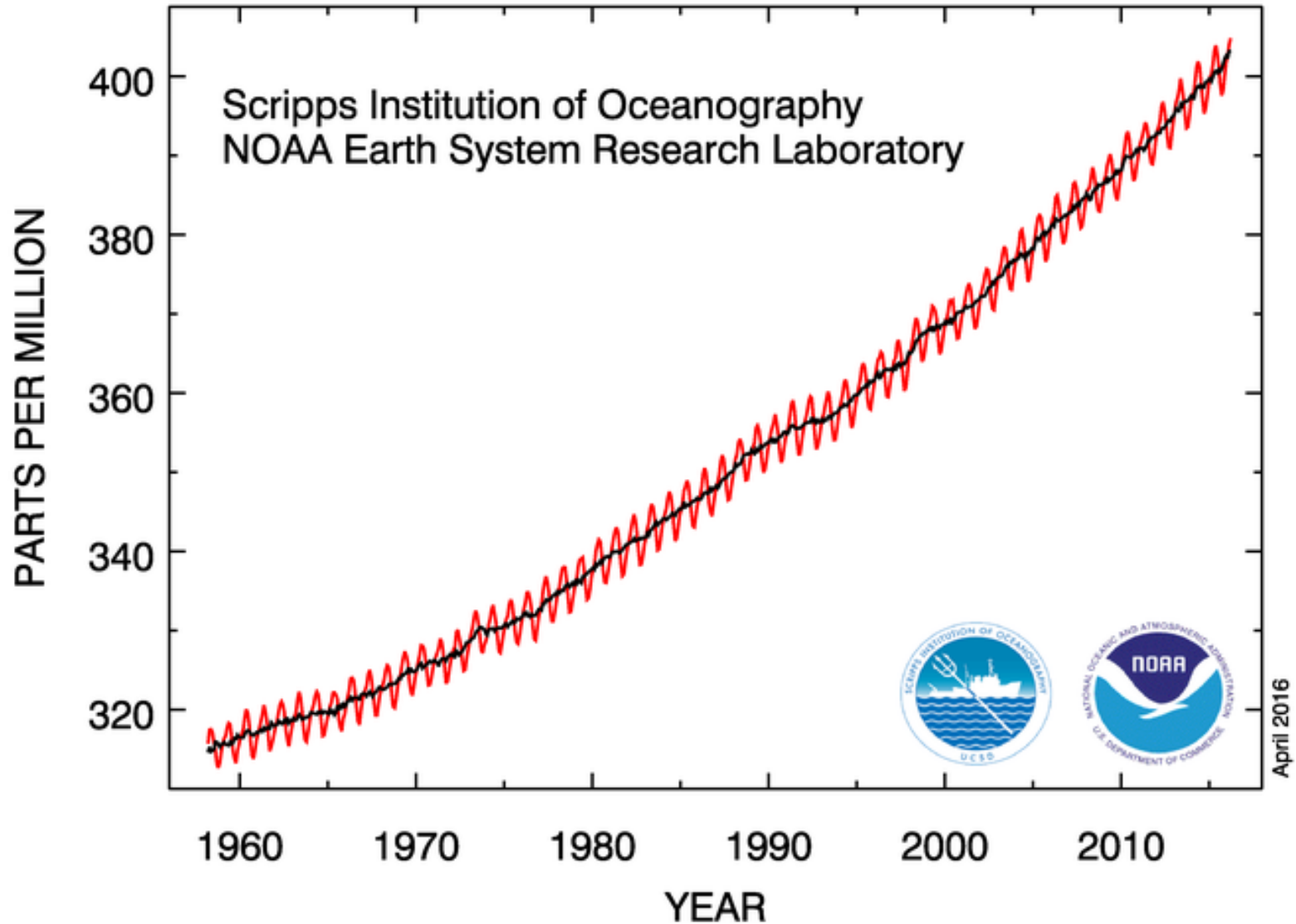


**Looking farther ahead gets
“very interesting”**

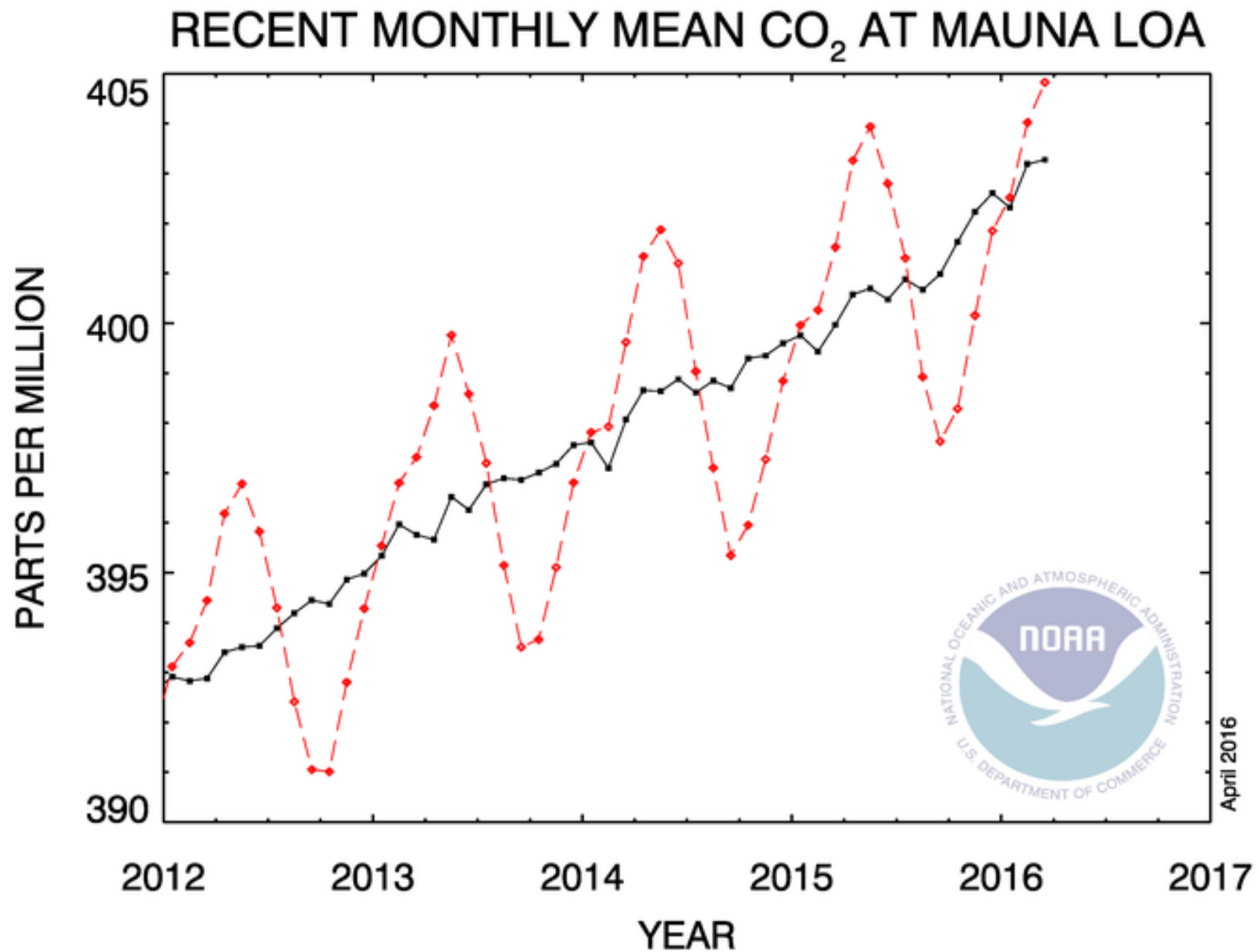


What do we do with this?

Atmospheric CO₂ at Mauna Loa Observatory

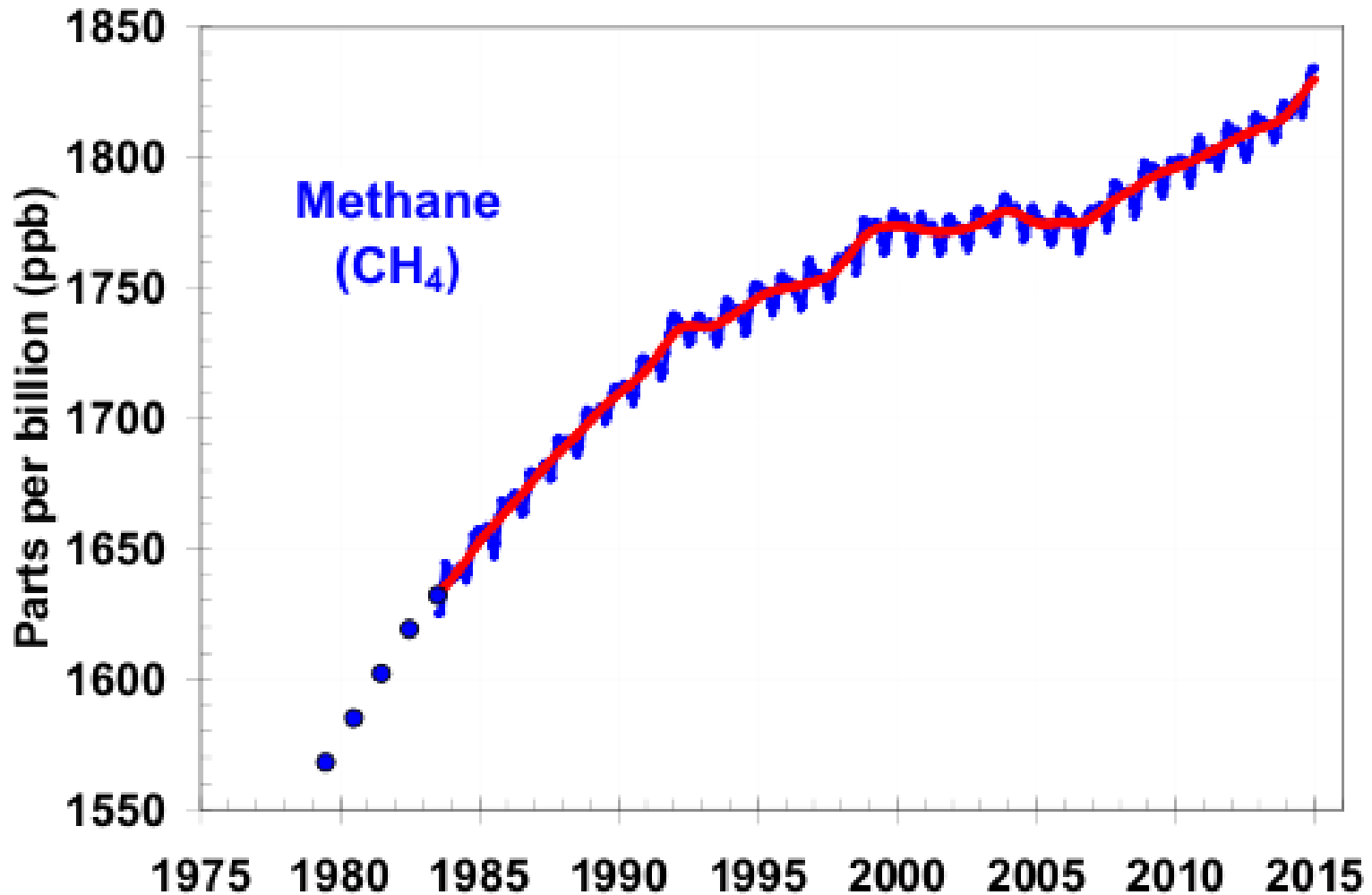


It is not yet slowing down

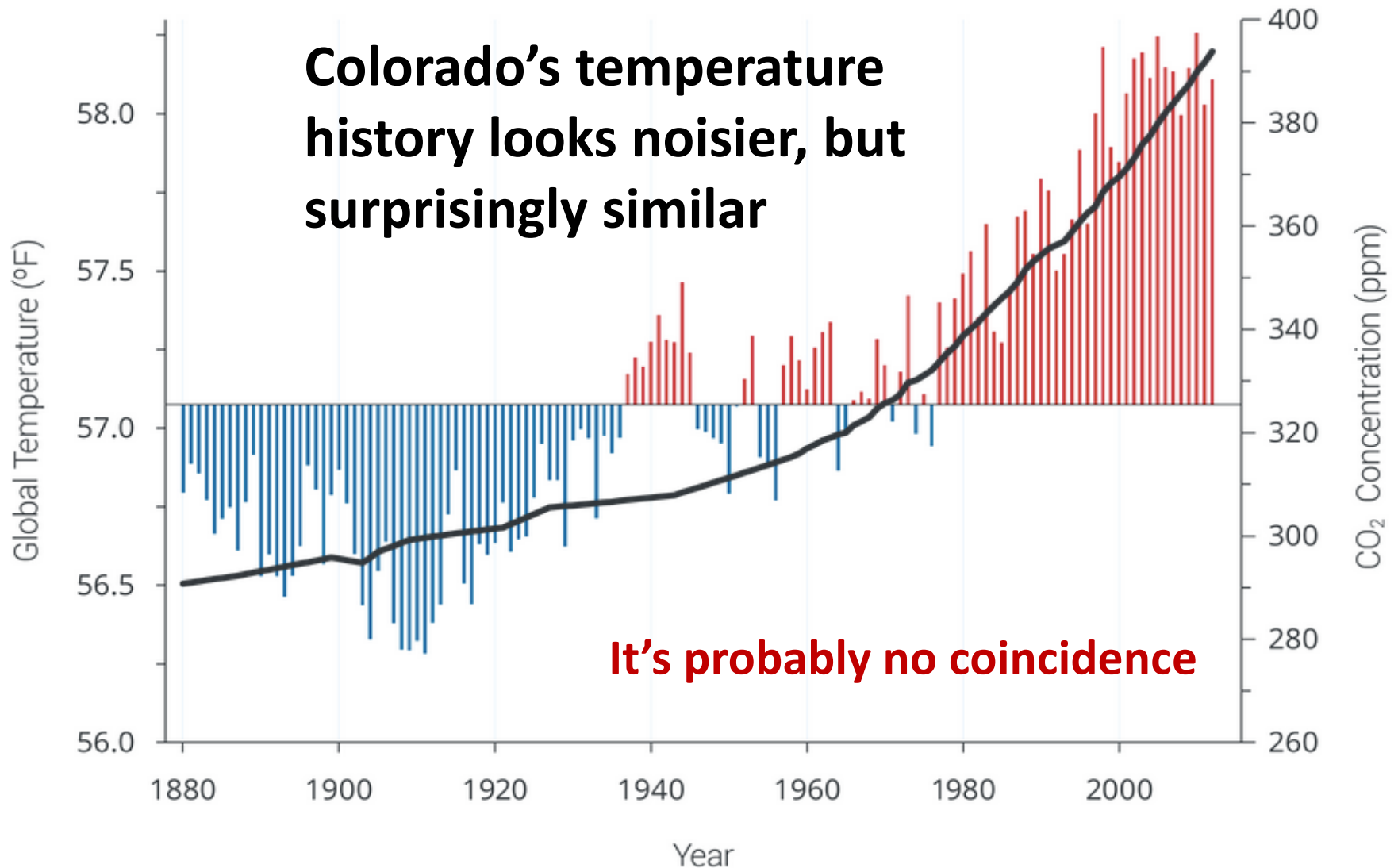


And this too - -

Atmospheric Methane on the rise again



Global Temperature and Carbon Dioxide



When in doubt, measure!

COCORAHHS

If you are interested in weather and the variations in precipitation, please join the Community Collaborative Rain, Hail and Snow Network

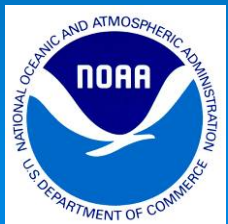
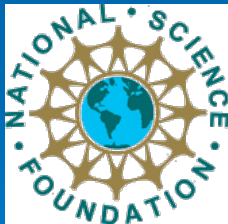
<http://www.cocorahhs.org>

or see me today

For information and to volunteer, visit the CoCoRaHS Web Site



<http://www.cocorahs.org>



Support for this project provided by
NSF Informal Science Education Program,
NOAA Environmental Literacy Program
and
many local charter sponsors.

Other Resources: Colorado Climate Trends Website

Colorado State University

Colorado Climate Trends

Climate Trends Home | Colorado Climate Center | CIRA | Atmospheric Science

[Colorado Climate Center](#) » [Climate Trends](#) » [Home](#)

Search by Google

Welcome to the Colorado Climate Trends Website

Climate Trends | [Station Map](#) | [Station Info](#) | [Data Access](#) | [Links + Resources](#) | [About](#)

Climate Trends of Colorado



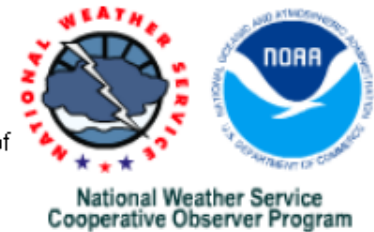
Welcome! The climate of Colorado is a valued natural resource affecting our lives and livelihoods. By nature, climate is variable. No two years are ever exactly alike. Instrumental observations of our climate dating back to the late 1800s give a sense of our average climate, typical variations, extremes and long-term trends. (For a description of historic weather observations in Colorado, click here). Tracking temperatures and precipitation through history reveal seasonal patterns, cold and warm periods, and episodes of drought and abundant water.

Today there is great interest in climate change. If our state is warming, these data will show it. This Website lets you view, graph and download historic temperature and precipitation data for selected weather stations in Colorado having the longest and most consistent historical data. Historic consistency is critical for accurately assessing climate trends. There have been hundreds of weather stations operated in Colorado since the 1890s, but very few have data that are complete and consistent. Even the best stations selected for this site are imperfect.

For each station shown here, a description of the history of the station is provided so that data users will know what factors may have affected the long-term time series. To learn more

National Weather Service Co-op Program

Weather observations in Colorado using thermometers and rain gauges date back to the late 1800s. Some of the earliest weather stations were established in the largest cities during the 1870s by the U.S. Signal Service. In the 1880s Colorado formed a "State Weather Service" and began setting up more basic weather stations in smaller towns and rural areas. By 1890, the first nationwide civilian weather service was formed within the U.S. Department of Agriculture. State networks, such as Colorado's were combined to form a single nationwide volunteer weather observing network. This same network continues today managed by the National Weather Service. What began as a few dozen stations in the 1880s grew to over 200 in the 1940s and 50s and continues today.



<http://climatetrends.colostate.edu>