

# Where is our climate taking us?

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CSU ClimateSmart Ag Conference  
5 May 2016  
Graphics by Zach Schwalbe



# Topics we will cover today

- Our data
- Colorado Climate Basics
- Observed trends
  - temperatures
  - growing season length
  - precipitation
  - drought
  - snowpack

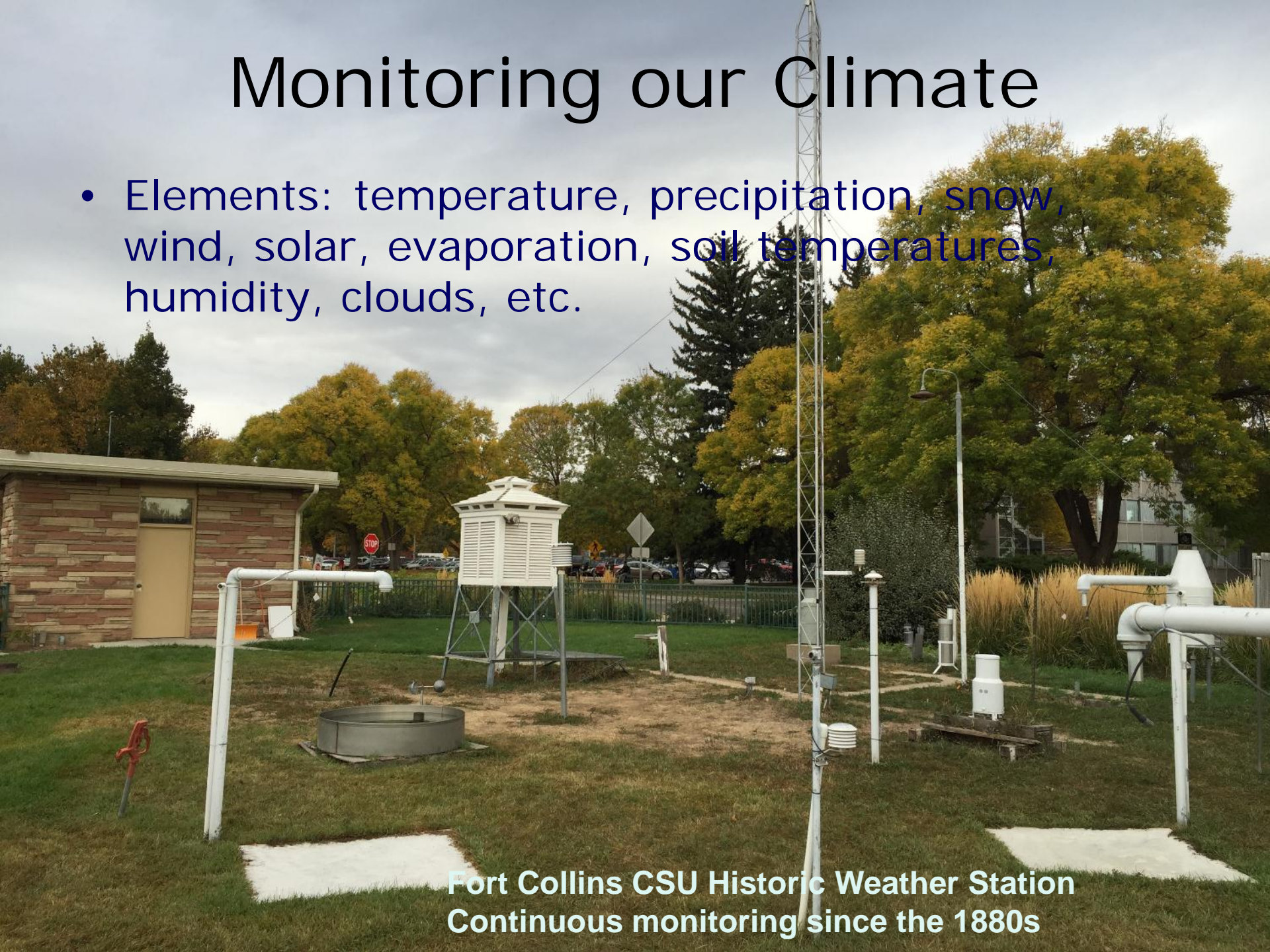
## Summary



Thanks to the National Weather Service for  
faithfully maintaining the Cooperative  
Observer Network since 1890  
Our historic baseline for temperature and  
precipitation

# Monitoring our Climate

- Elements: temperature, precipitation, snow, wind, solar, evaporation, soil temperatures, humidity, clouds, etc.



**Fort Collins CSU Historic Weather Station  
Continuous monitoring since the 1880s**

# Hug your weather station!

## The Historic Fort Collins Weather Station

National Weather Service Cooperative Station 05-3005

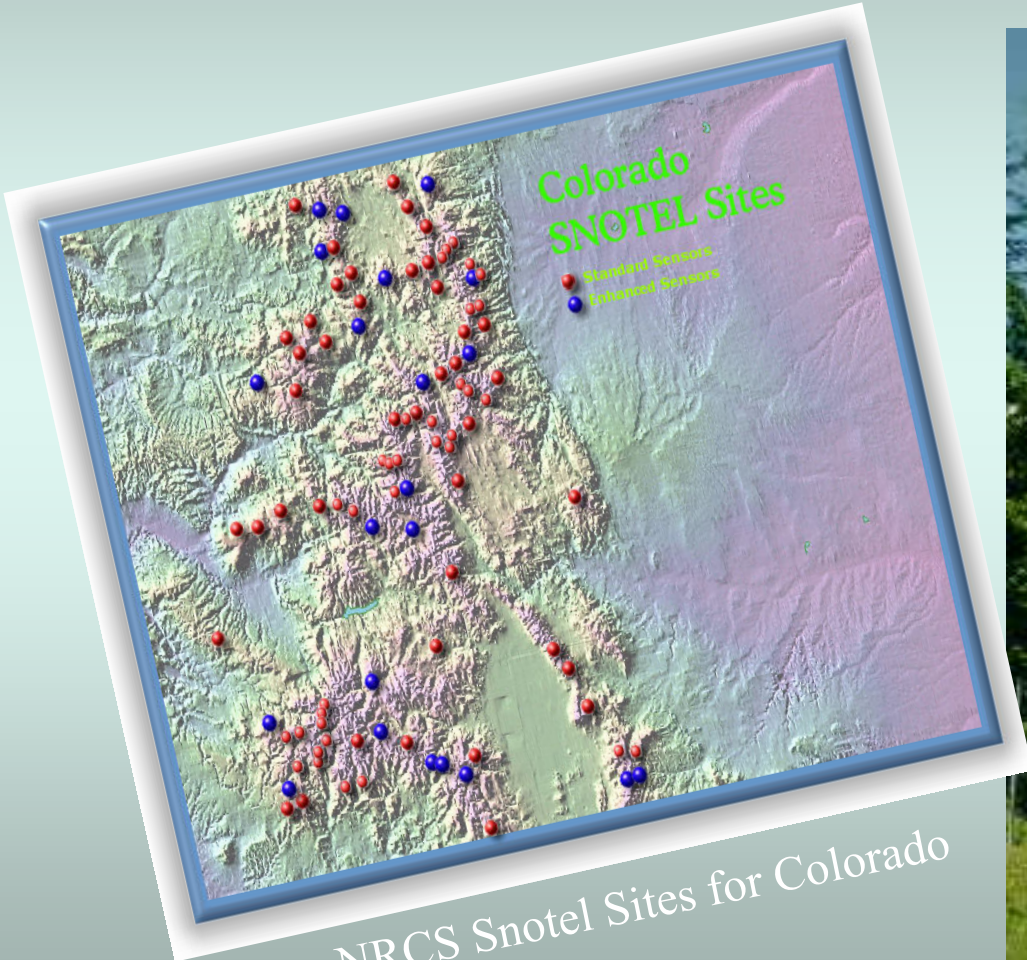
This is one of the longest operating weather stations in the western U.S. monitoring temperature, humidity, precipitation (rain, hail and snow), evaporation, winds, solar radiation, clouds, visibility, barometric pressure and soil temperatures. Weather observations for research, teaching and public information have been conducted on campus since the early 1870s. Continuous support for this historic weather station has been provided by the Colorado Agricultural Experiment Station since 1889.

Early data collected here aided agricultural and irrigation research and development. Beginning in the 1930s, this station provided weather support for aviation and transportation safety. Uses continue to expand today. Data are publicly available for tracking climate trends, variations and extremes and their impacts here in northern Colorado.



Colorado State University

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



NRCS Snotel Sites for Colorado



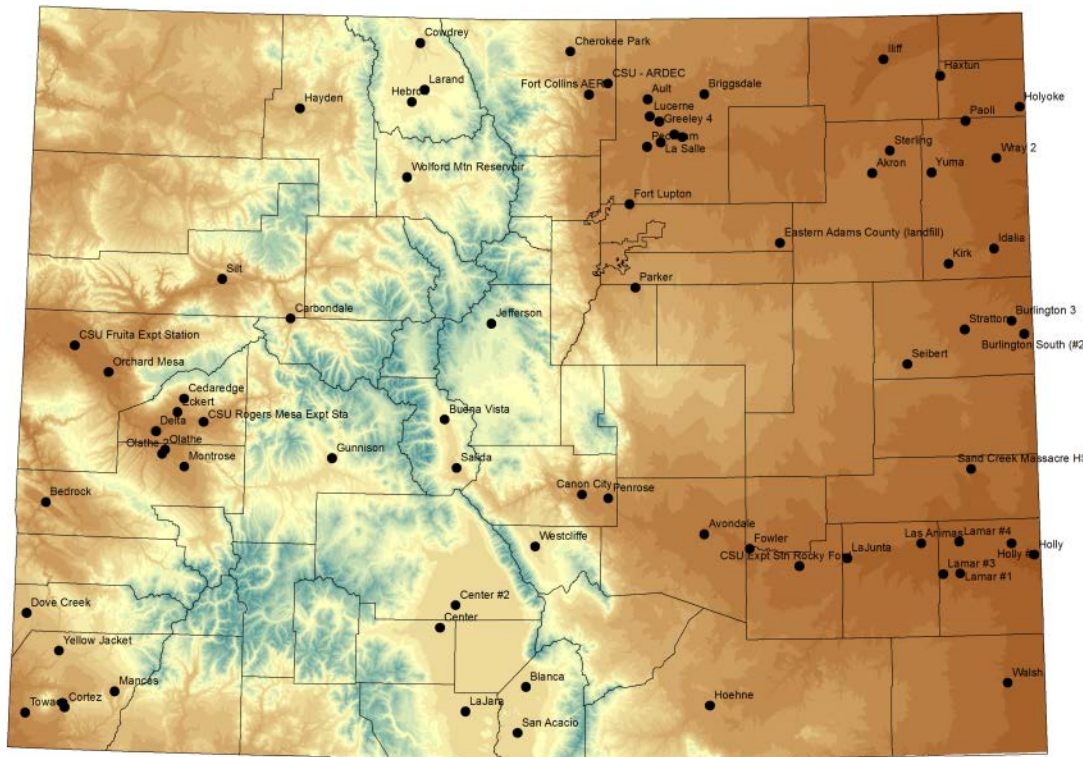
Typical NRCS Snotel Site

# Snow surveys began in the 1930s to help predict streamflow



Credit: NOAA Photo Library

# CSU's Colorado Agricultural Meteorological Network "CoAgMet"



**THANKS!! to those of  
You who help support  
CoAgMet**

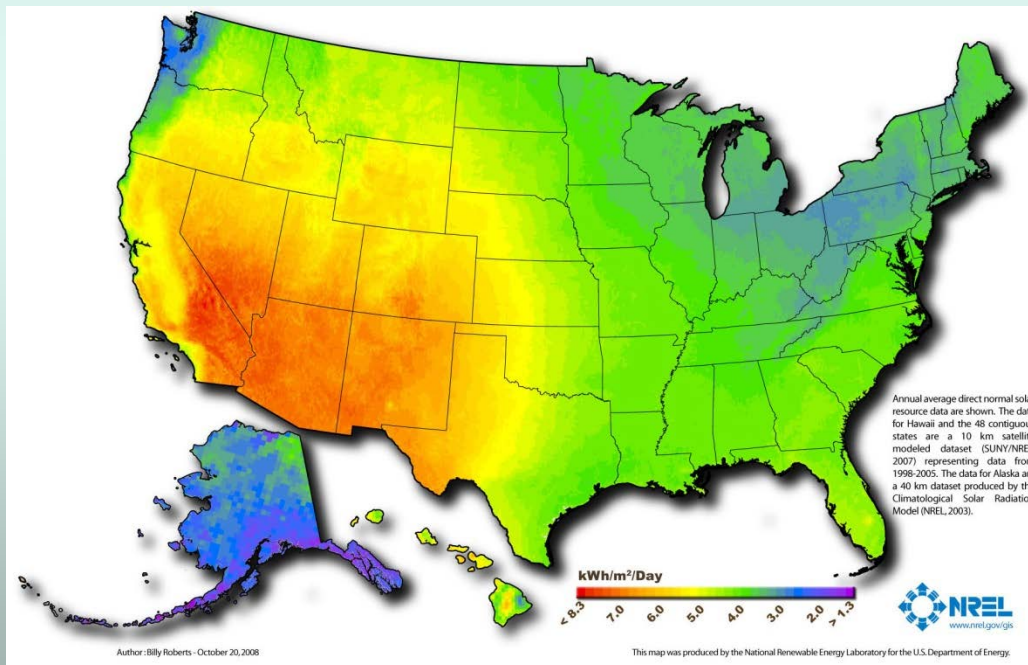
# What Makes Our Colorado Climate

- High elevation (highest state by far)
- Mid-Latitude location (lively seasonal changes)
- Interior Continental Location far from moisture sources
- Complex Mountain topography
- Solar energy and seasonal cycles drive our climate

**What have we  
learned from 125  
years of continuous  
climate monitoring?**

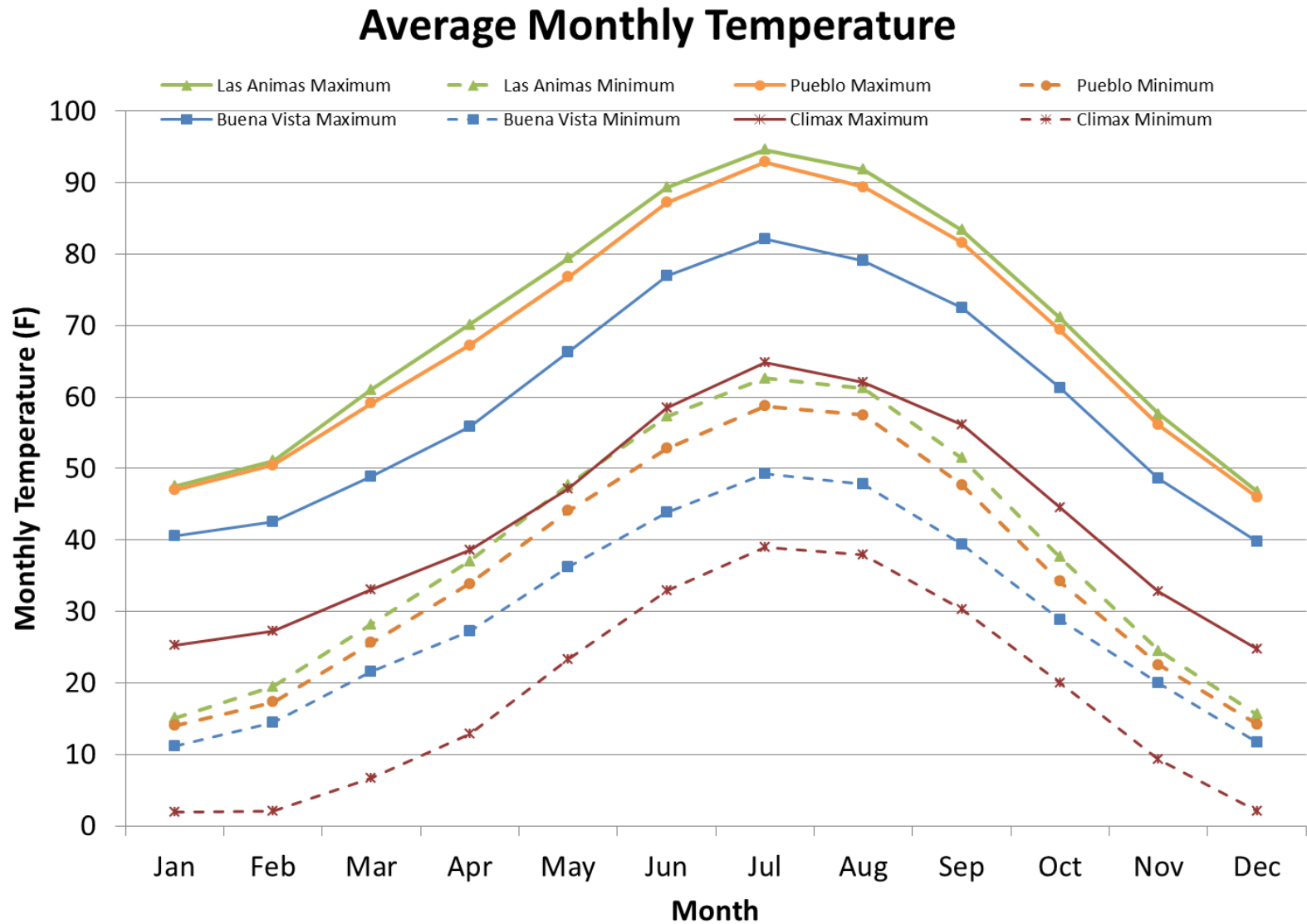


# Colorado is a sunny place People like sunshine!

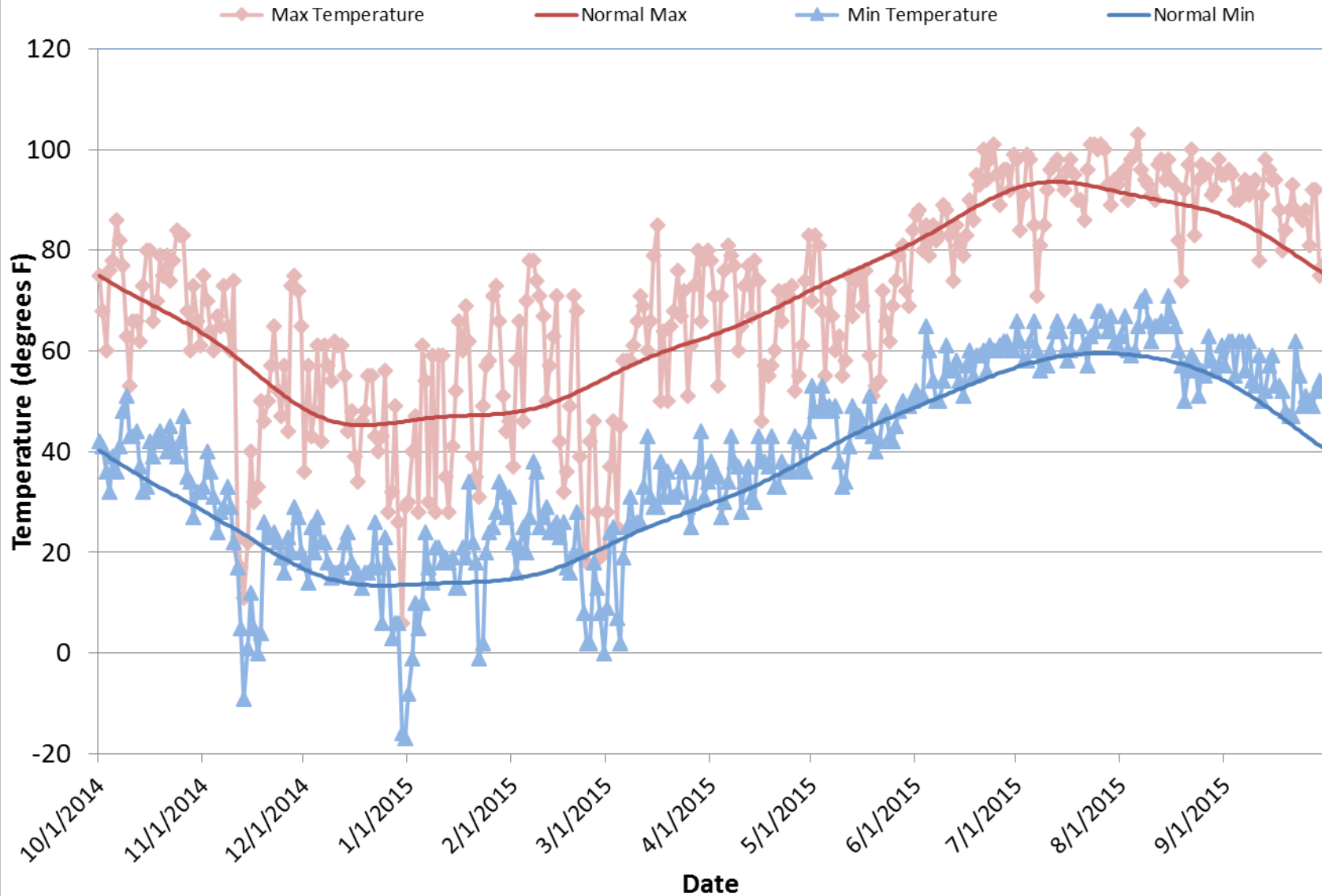


National Renewal Energy Laboratory: [www.nrel.gov](http://www.nrel.gov)

# The annual cycle of Colorado Temperatures

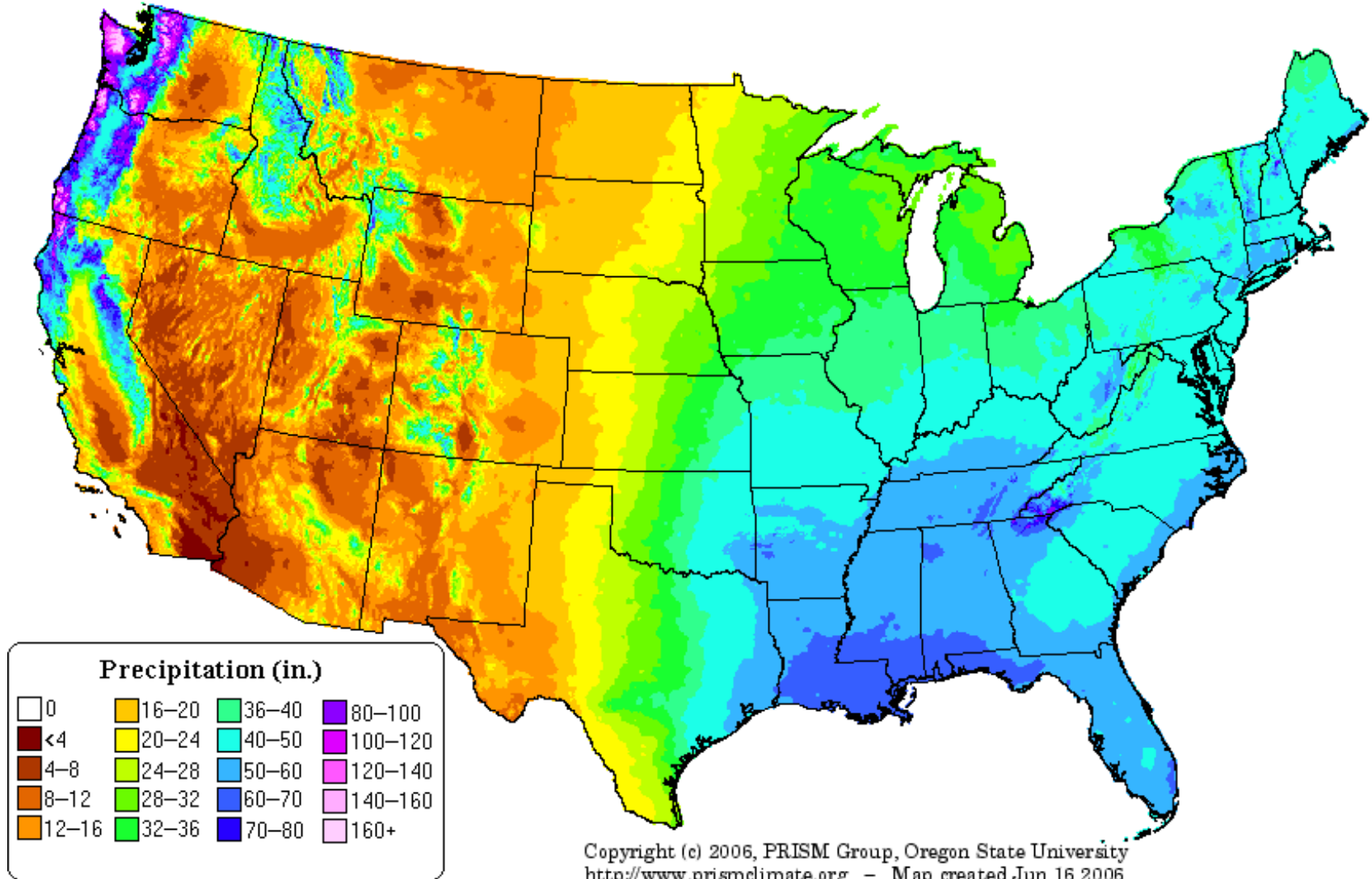


# Pueblo Airport Daily Max/Min Temperatures and Normal for Water Year 2015

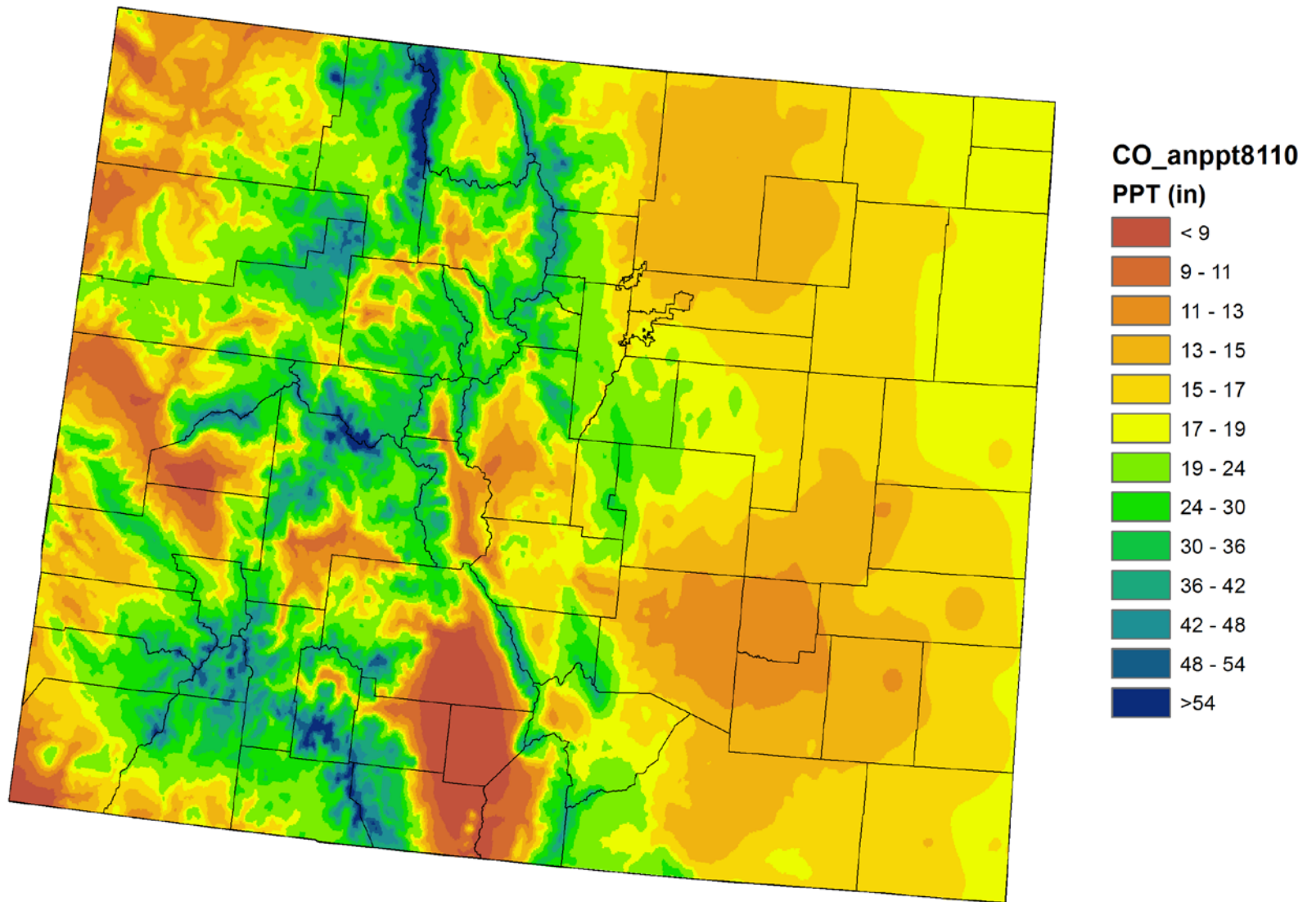


# U.S. Average Precipitation

Precipitation: Annual Climatology (1971–2000)



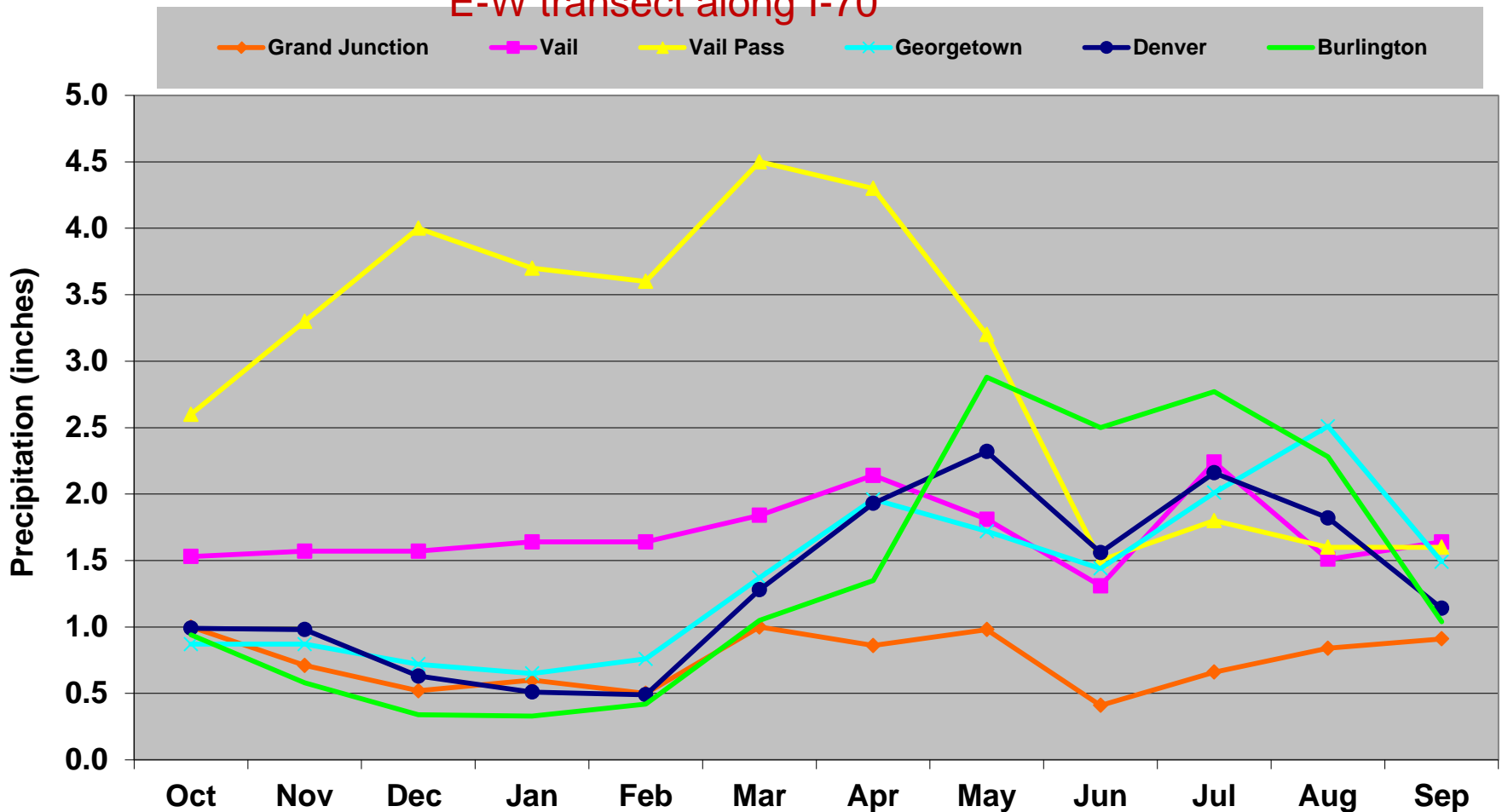
# Colorado Annual Average Precipitation (in) 1981-2010



# Seasonal Precipitation in Colorado varies greatly from place to place

Water Year Average Precipitation for Selected Stations

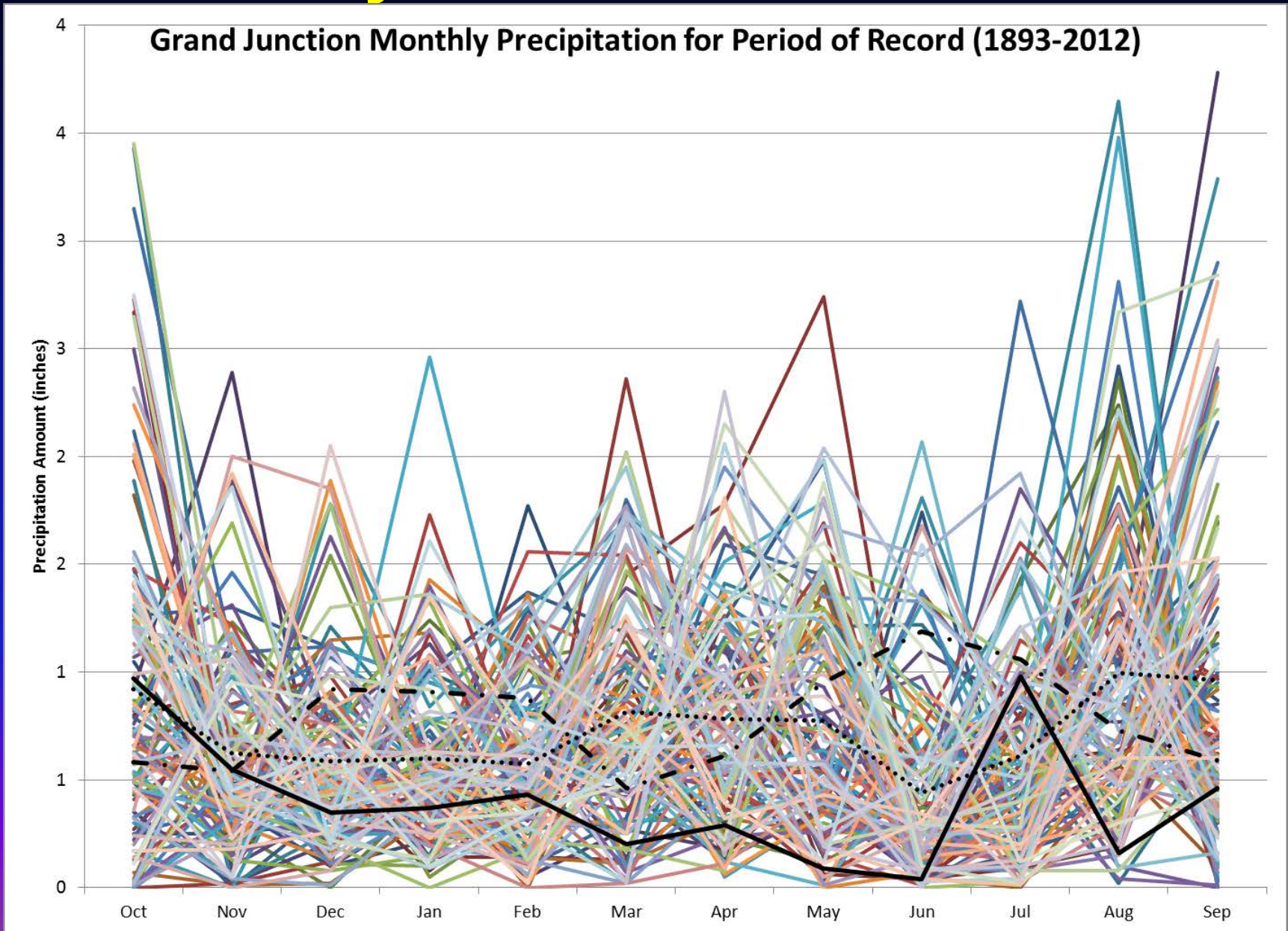
E-W transect along I-70



# Year-to-Year Variations in Precipitation are Huge



# No two years are ever the same



**A few storm systems each year make  
the difference between**



**Photo Credit: Henry Reges**

# Too much





South

Platte

River

1  
mile

September  
2013 South  
Platte River

Was that forecast?

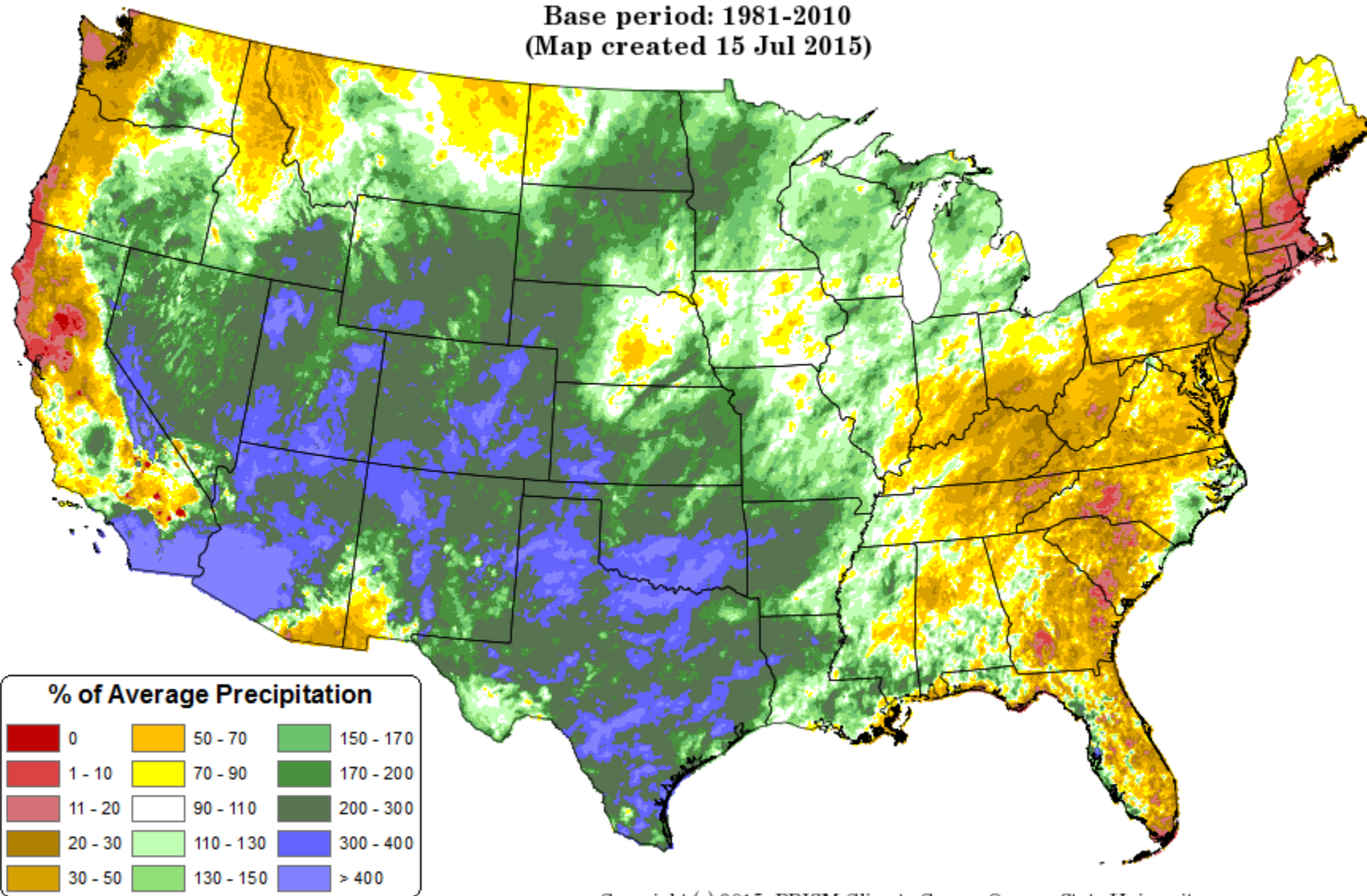


# Total Precipitation Anomaly: May 2015

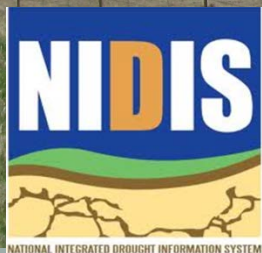
Period ending 31 May 2015

Base period: 1981-2010

(Map created 15 Jul 2015)



# And too little





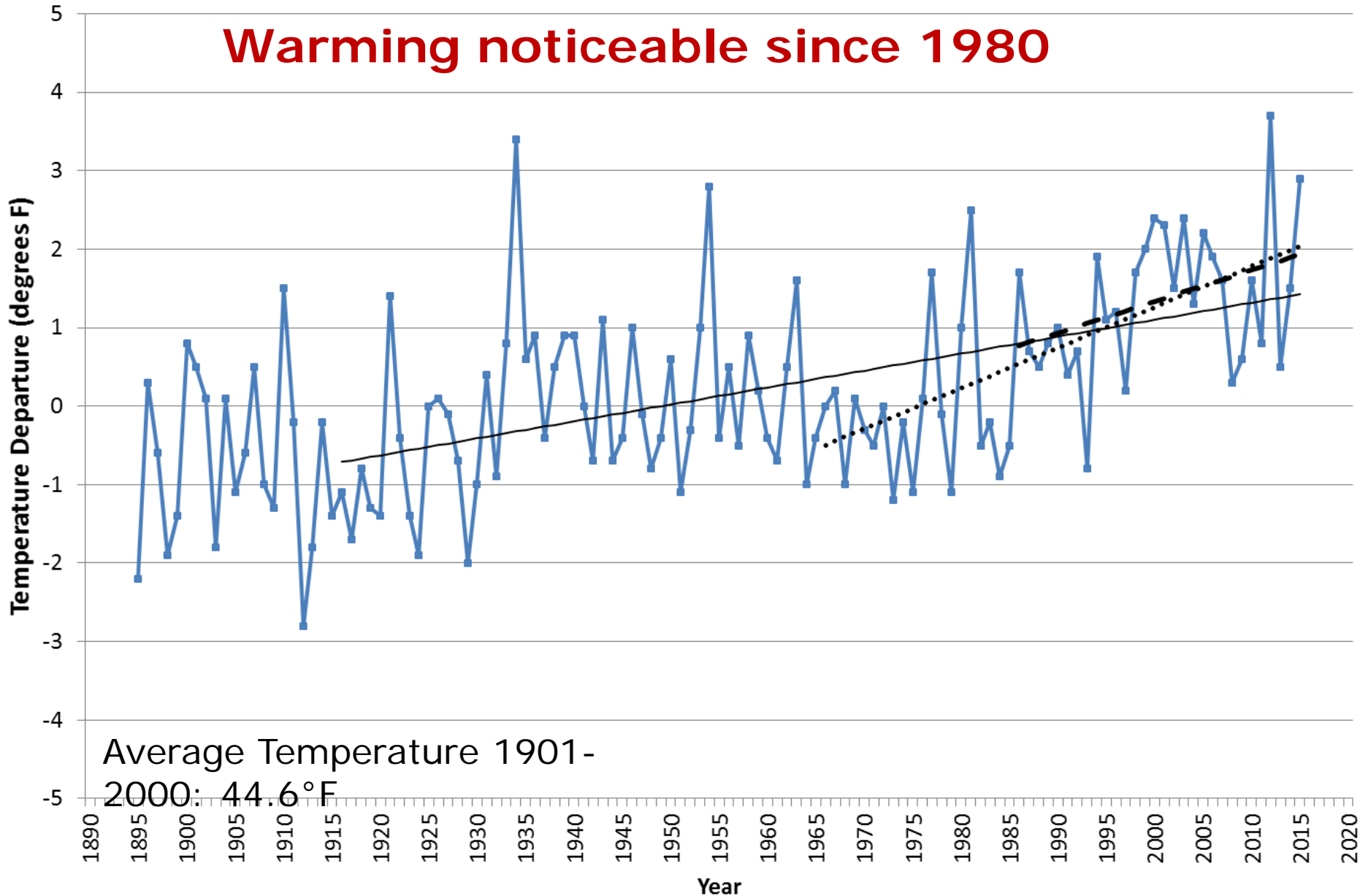
Paonia Reservoir  
August 2012



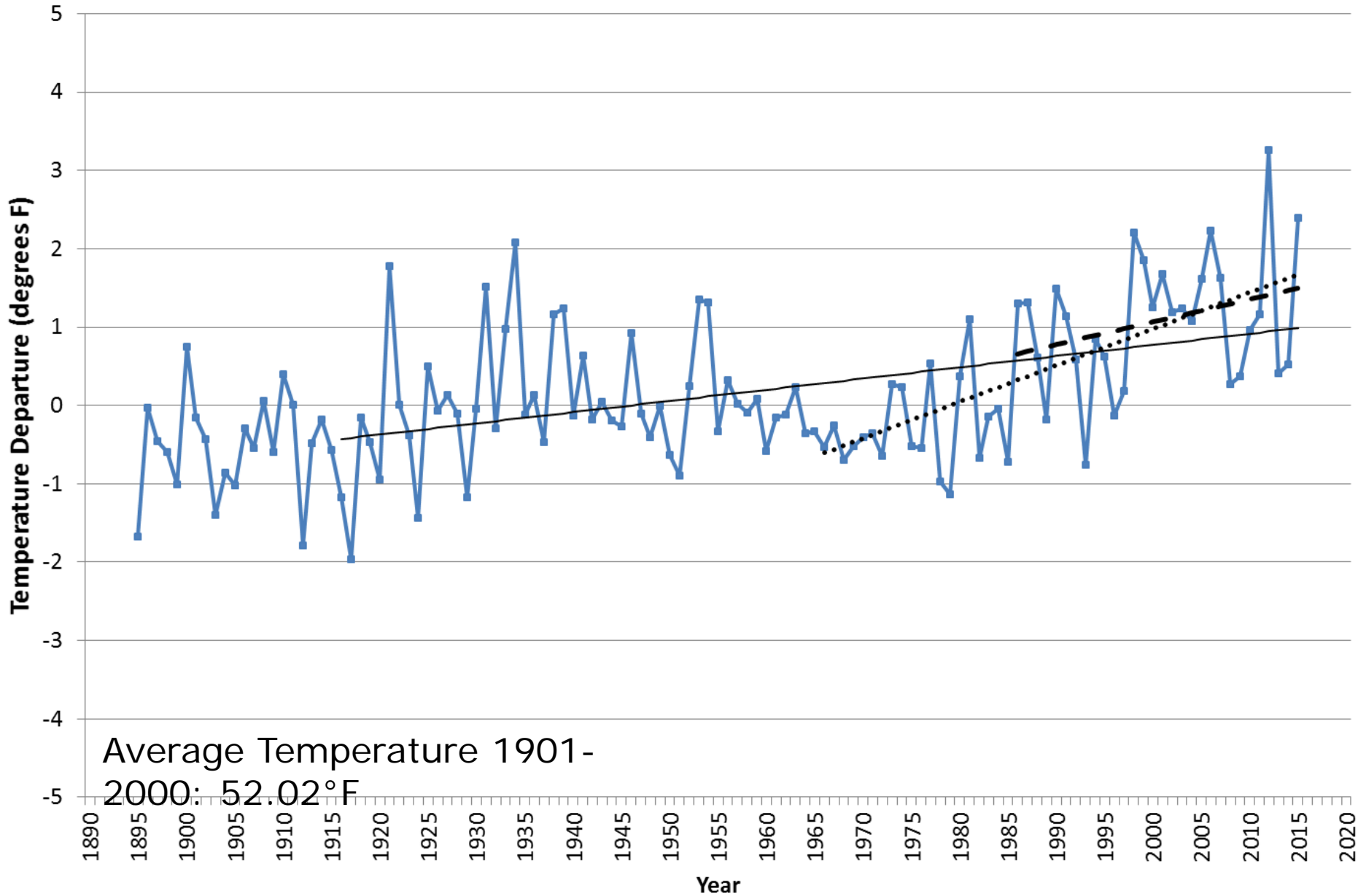
**What do our long term  
data tell us about  
changing temperatures**

# Colorado Temperature Departure from Average

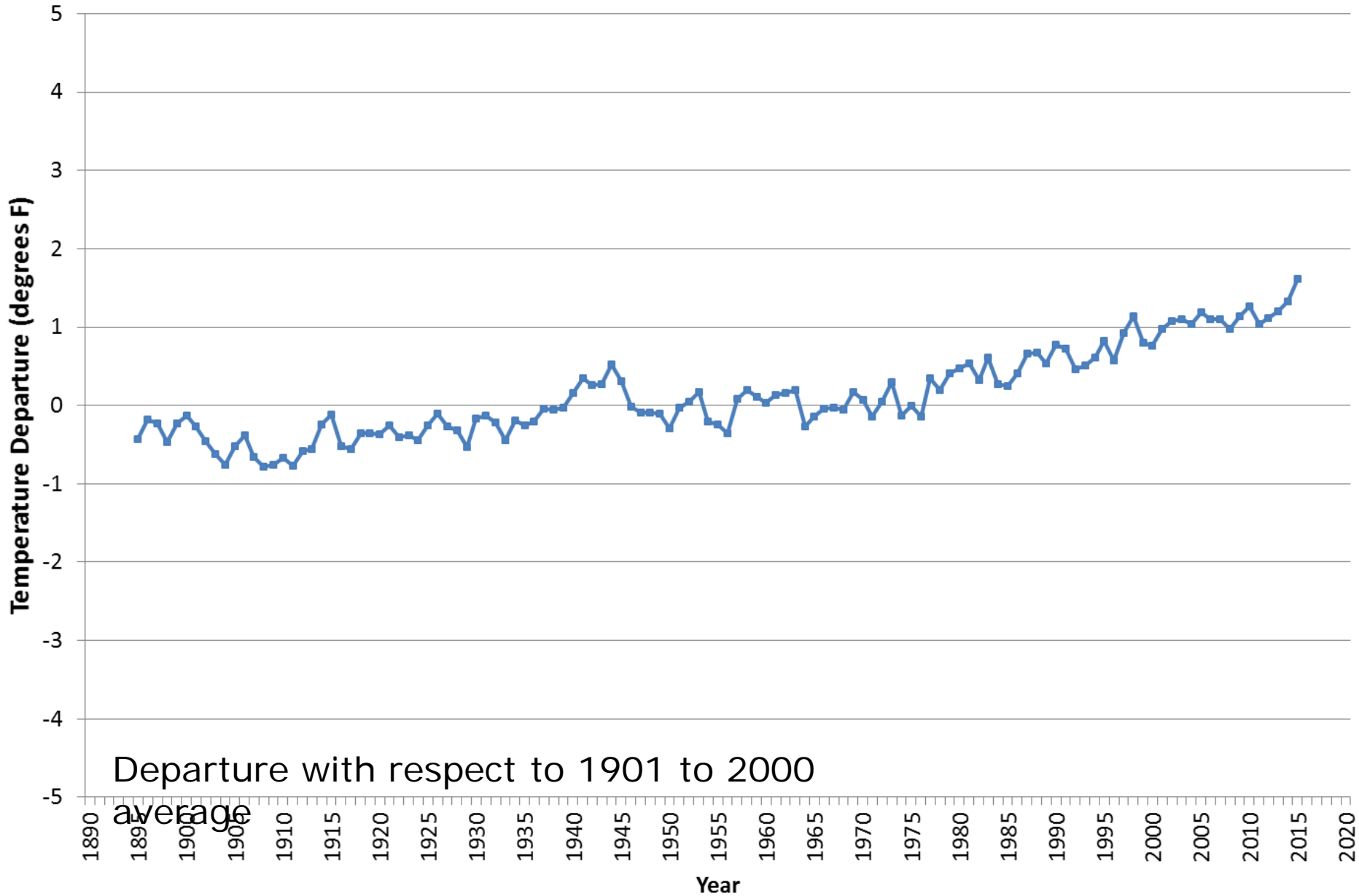
**Warming noticeable since 1980**



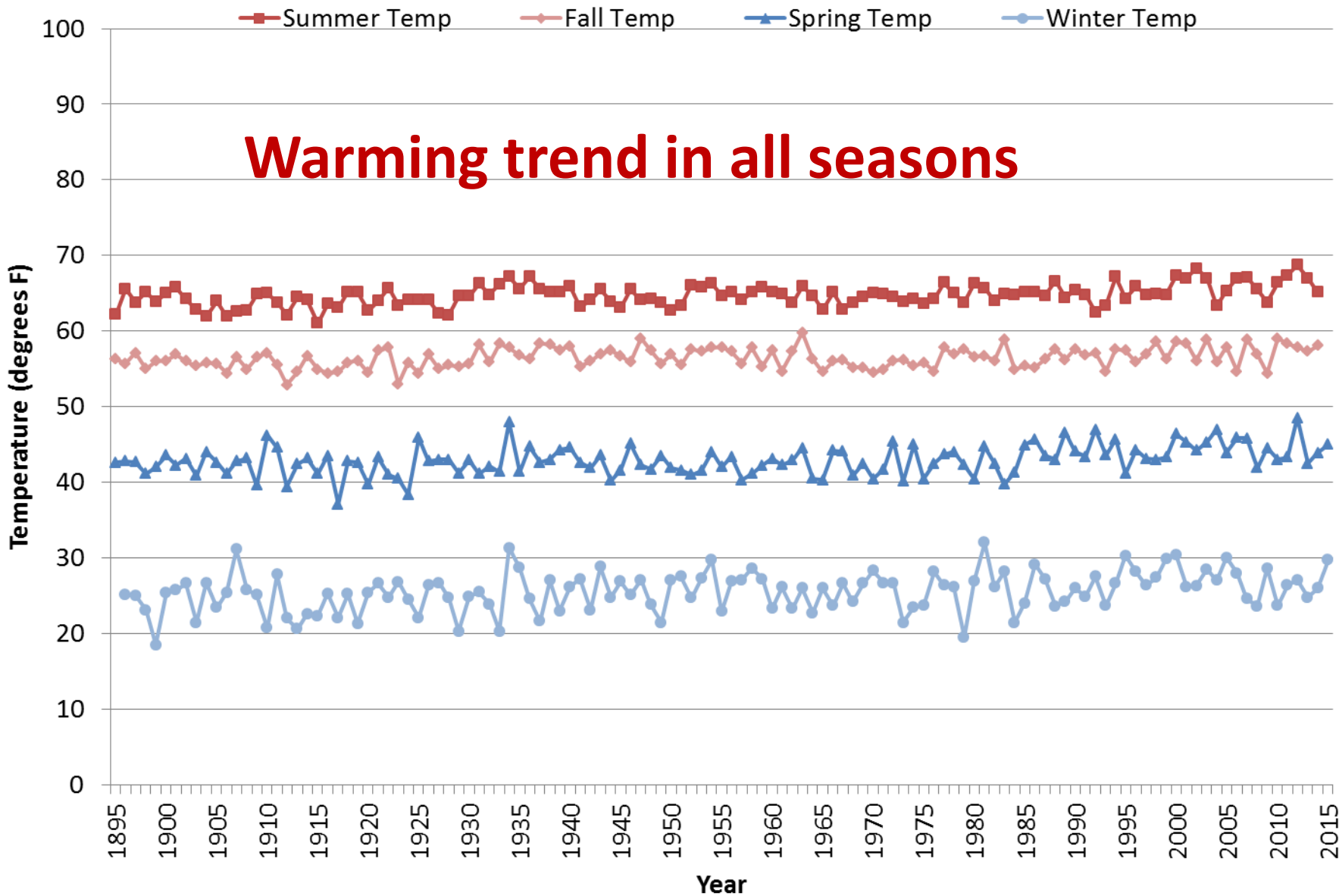
# U.S. Temperature Departure from Average



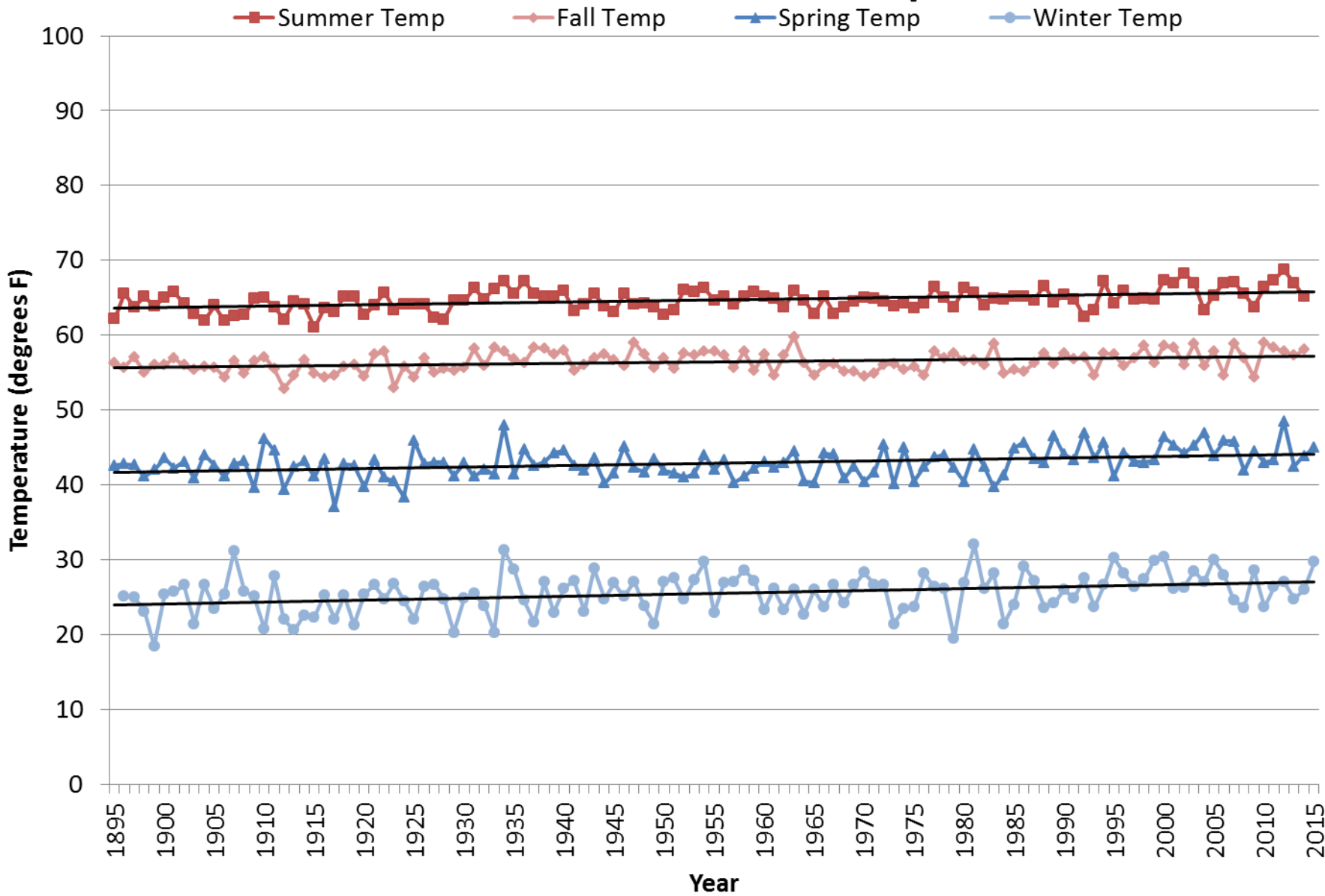
# Global Temperature Departure from Average



# Colorado Statewide Seasonal Temperature

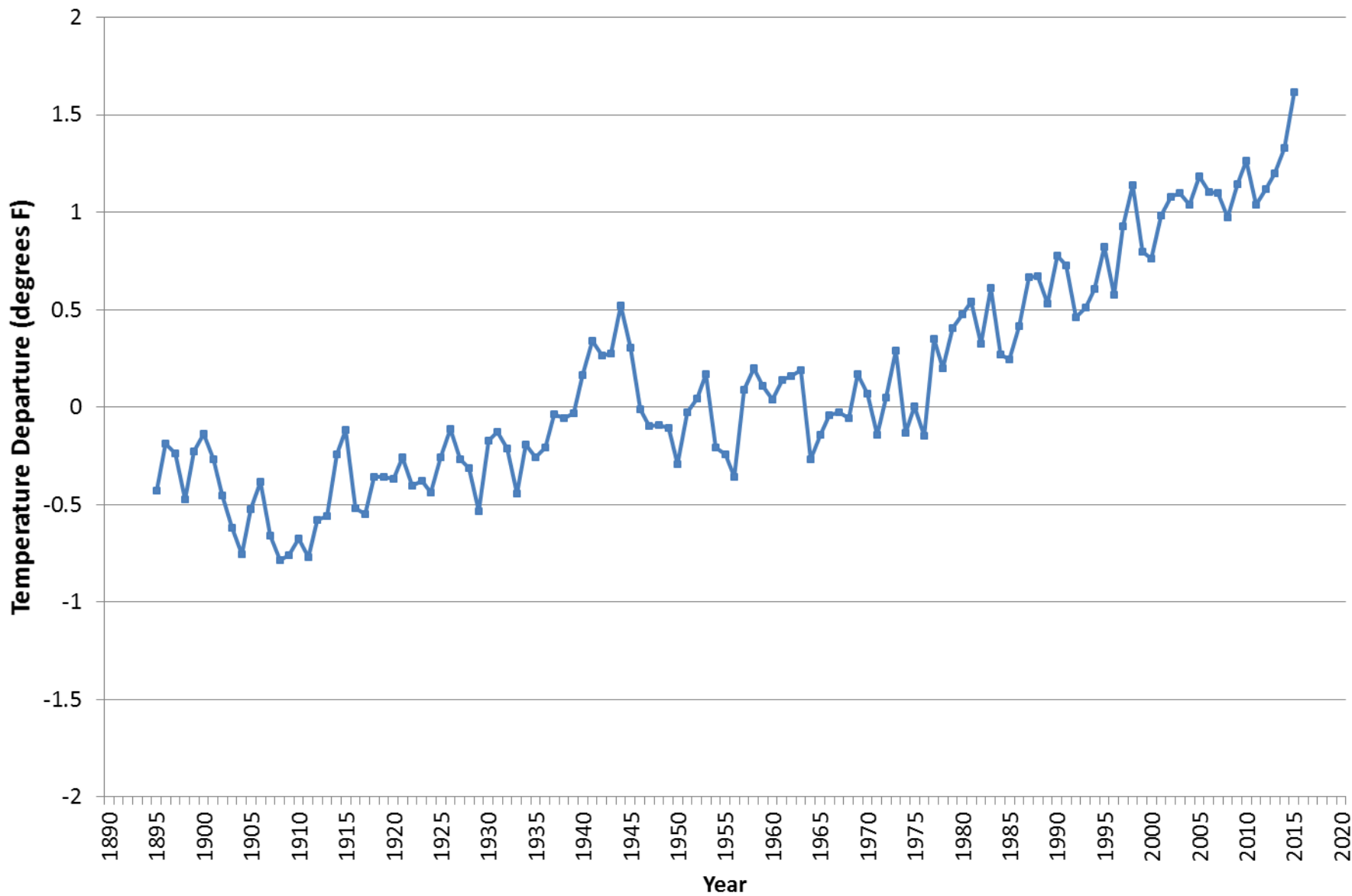


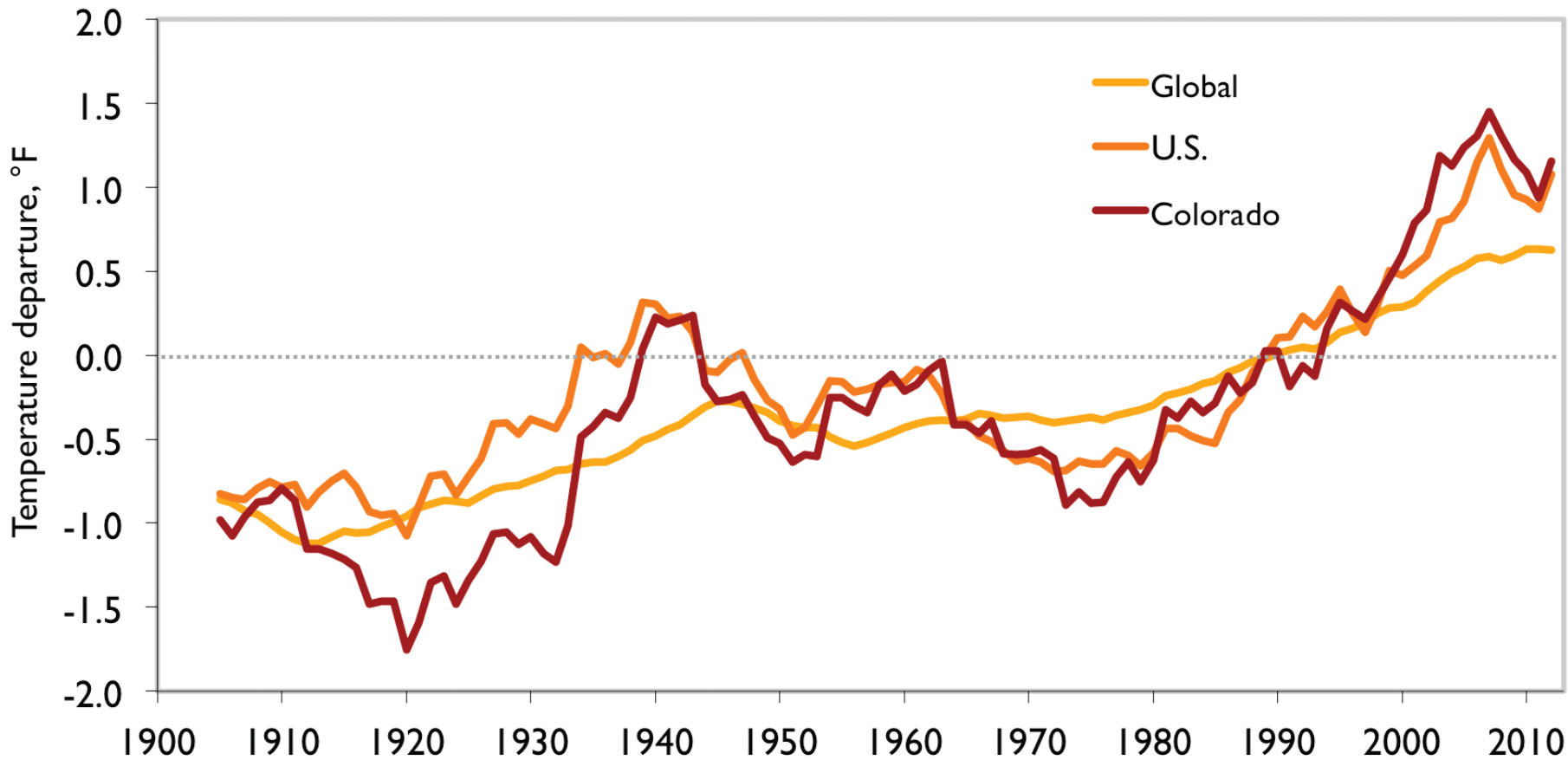
# Colorado Statewide Seasonal Temperature



Expand the scale, and then  
the trends catch your  
attention more

# Global Temperature Departure from Average



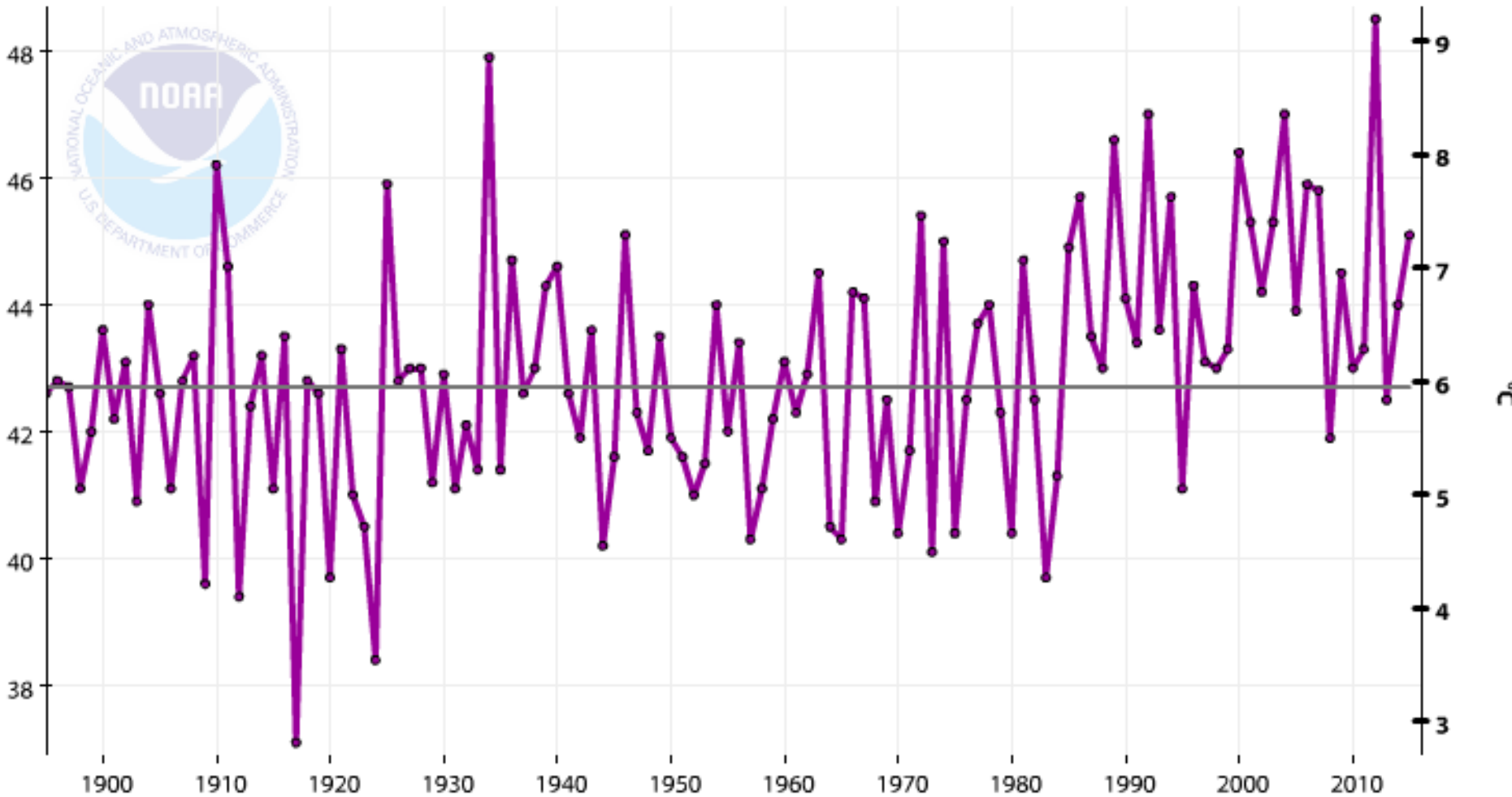


# Spring (MAM) Statewide Temperatures 1895-2015

## 17<sup>th</sup> warmest

Colorado, Average Temperature, March-May

1901-2000 Avg: 42.7°F      Avg Temperature



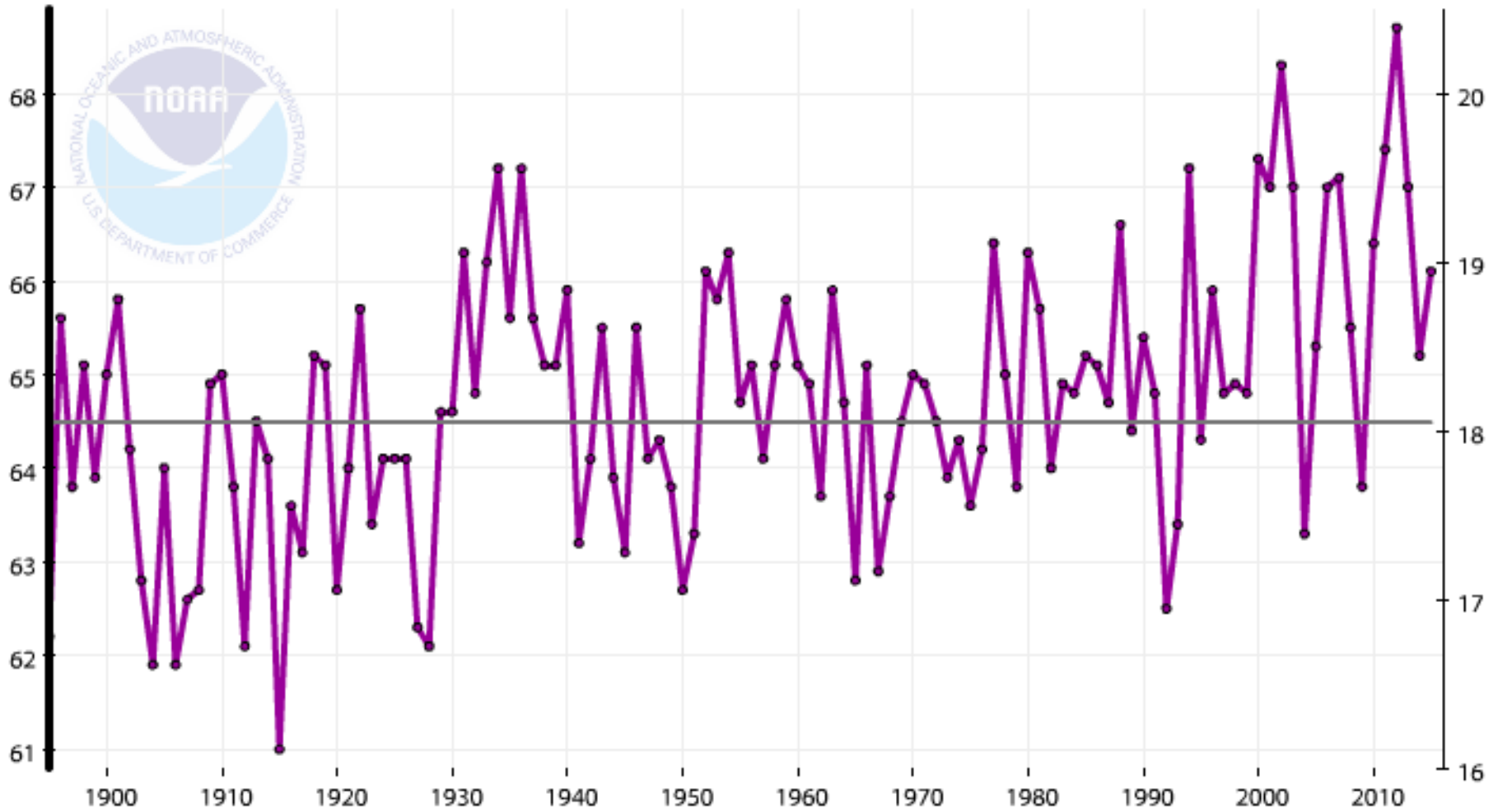
# Summer (JJA) Statewide Temperatures 1895-2015

## 21<sup>st</sup> warmest

### Colorado, Average Temperature, June-August

— 1901-2000  
Avg: 64.5°F

—●— Avg Temperature



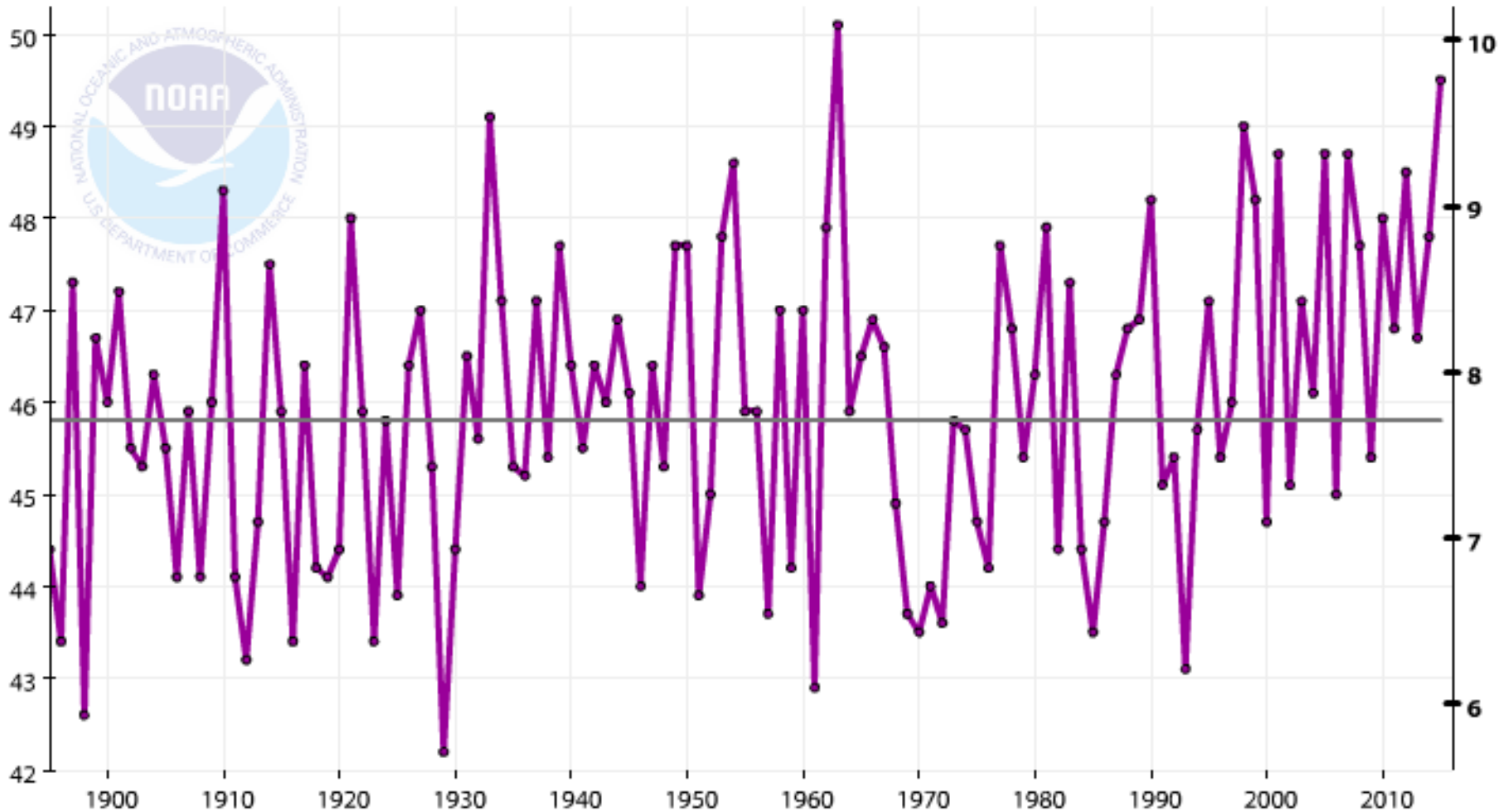
# 2015 (SON) Statewide Temperatures 1895-2015

## 2<sup>nd</sup> warmest

Colorado, Average Temperature, September-November

1901-2000  
Avg: 45.8°F

Avg Temperature

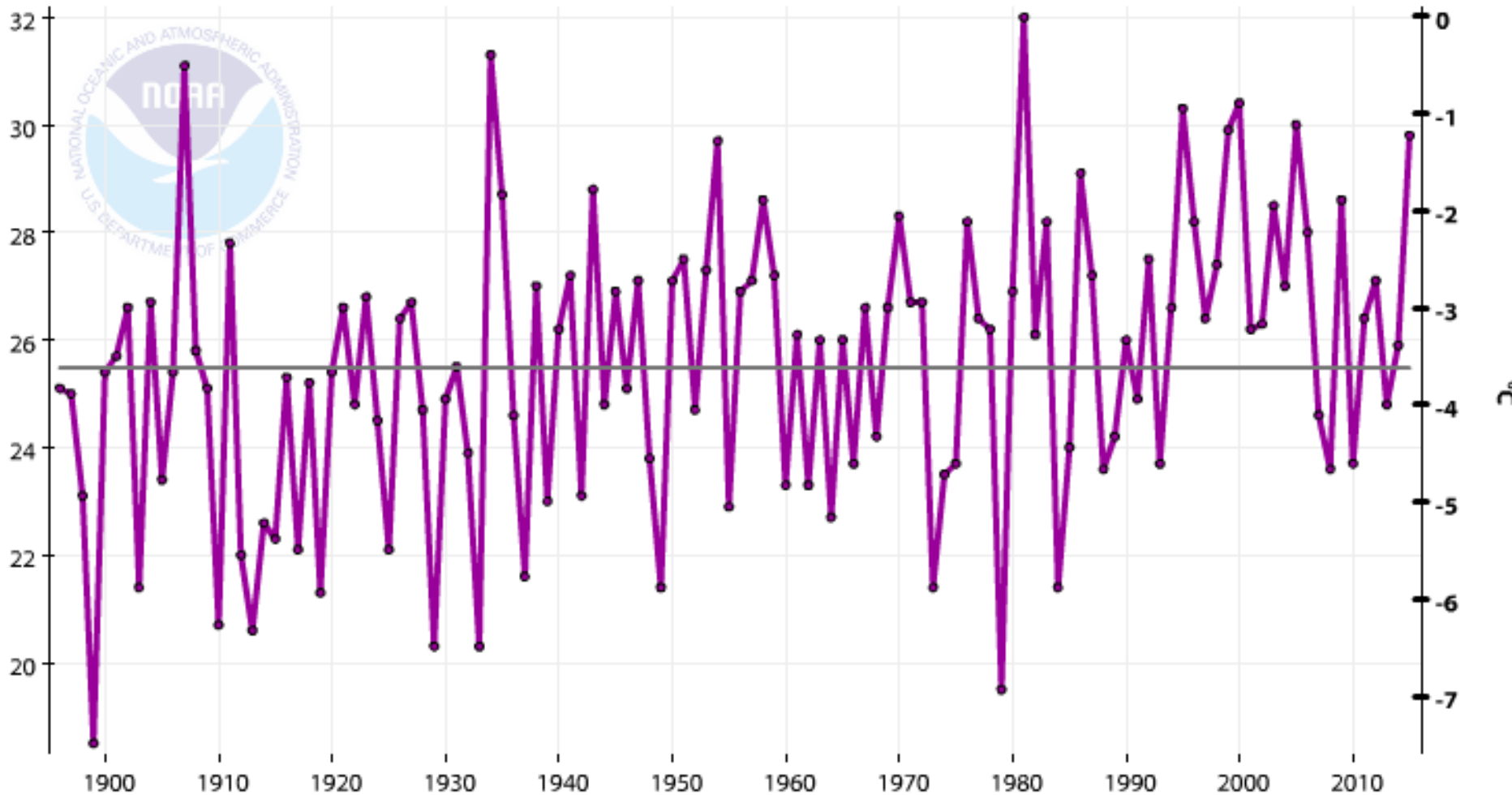


# Winter (DJF) Statewide Temperatures 1895-2015

## 8<sup>th</sup> warmest

Colorado, Average Temperature, December-February

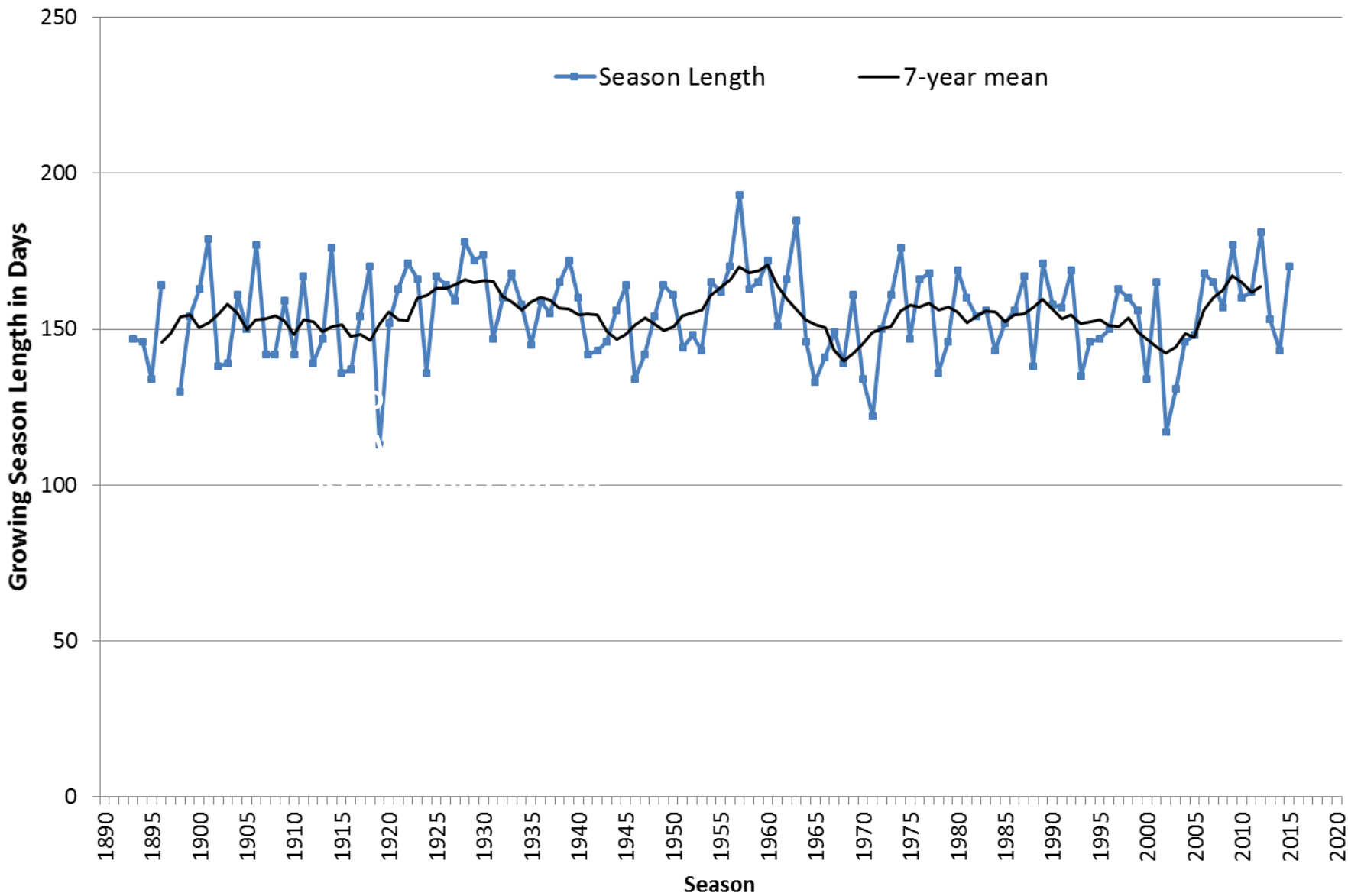
— 1901-2000 Avg: 25.5°F      —●— Avg Temperature



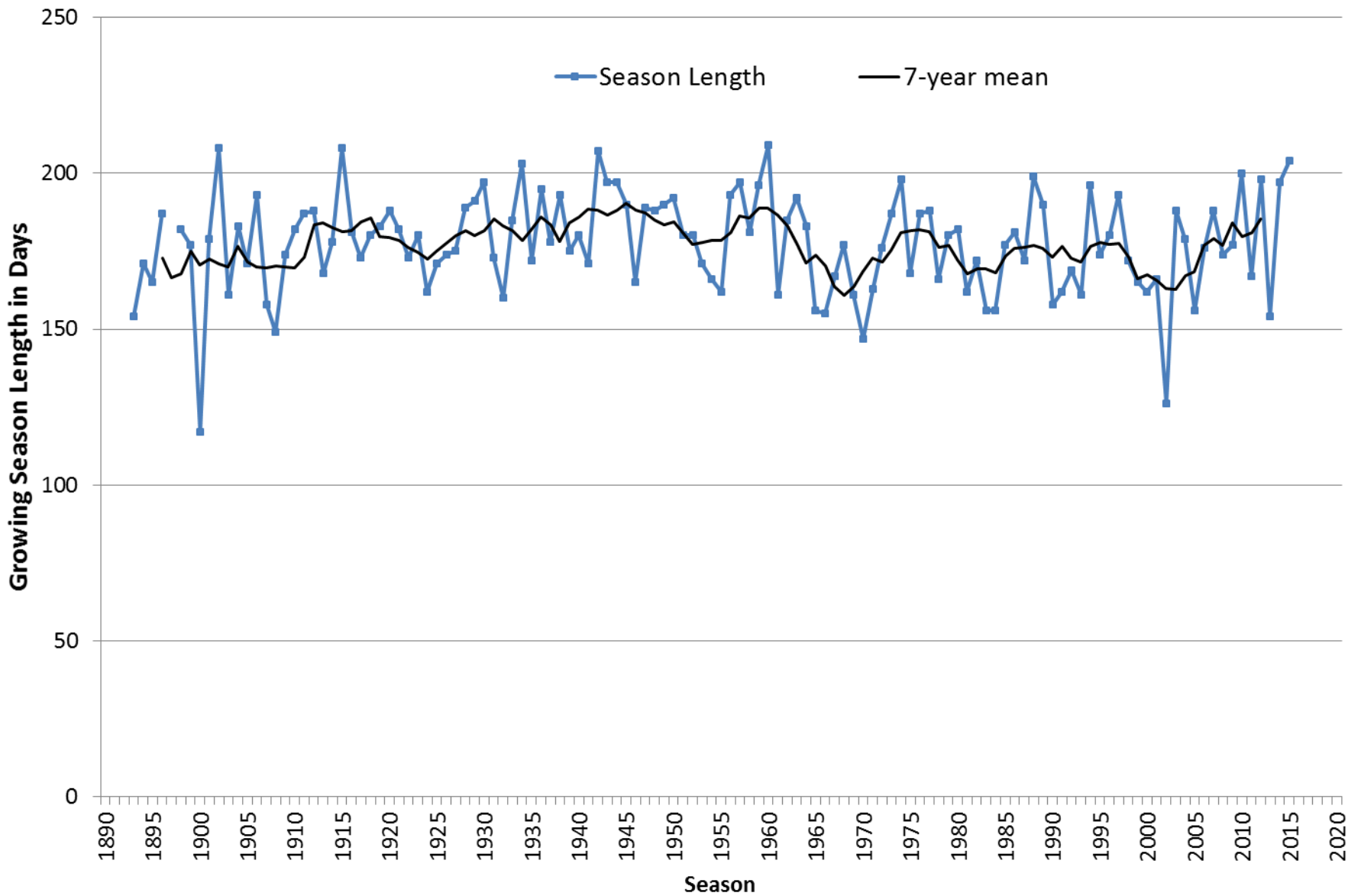
**Growing season length: days between  
last spring freeze and first fall freeze**

**This story is not as clear**

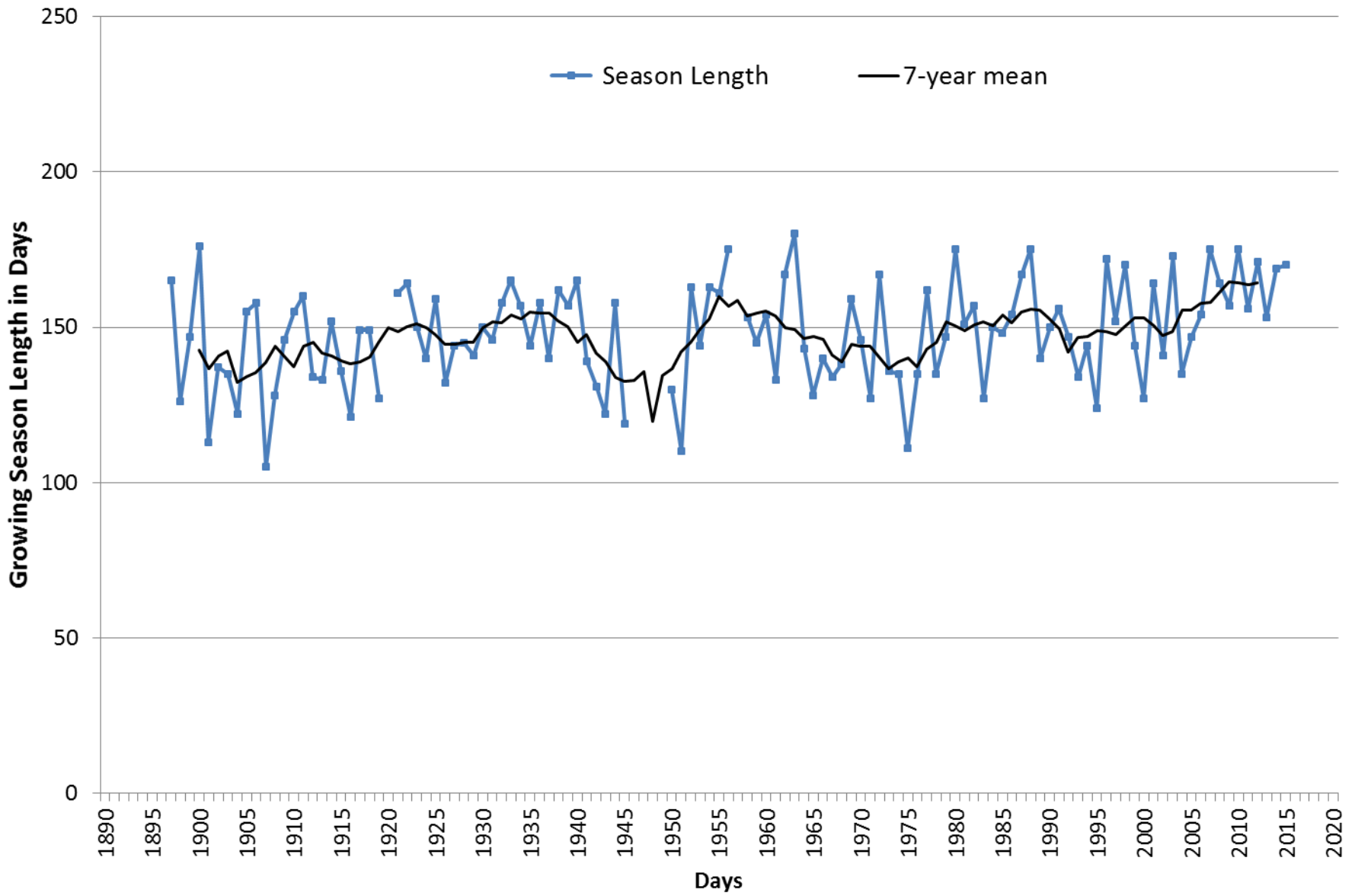
# Rocky Ford Growing Season Length using 32°F



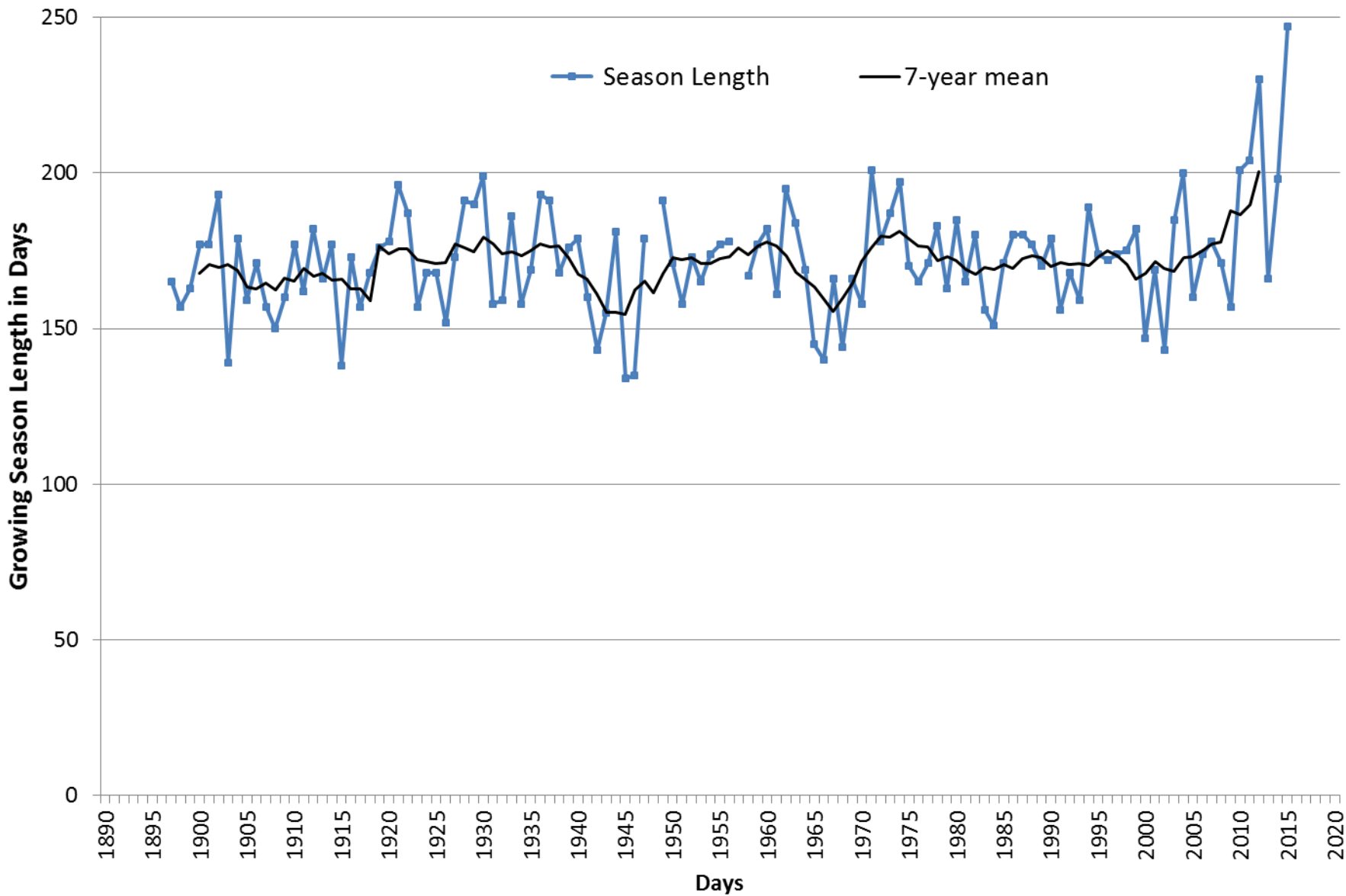
# Rocky Ford Growing Season Length using 28°F



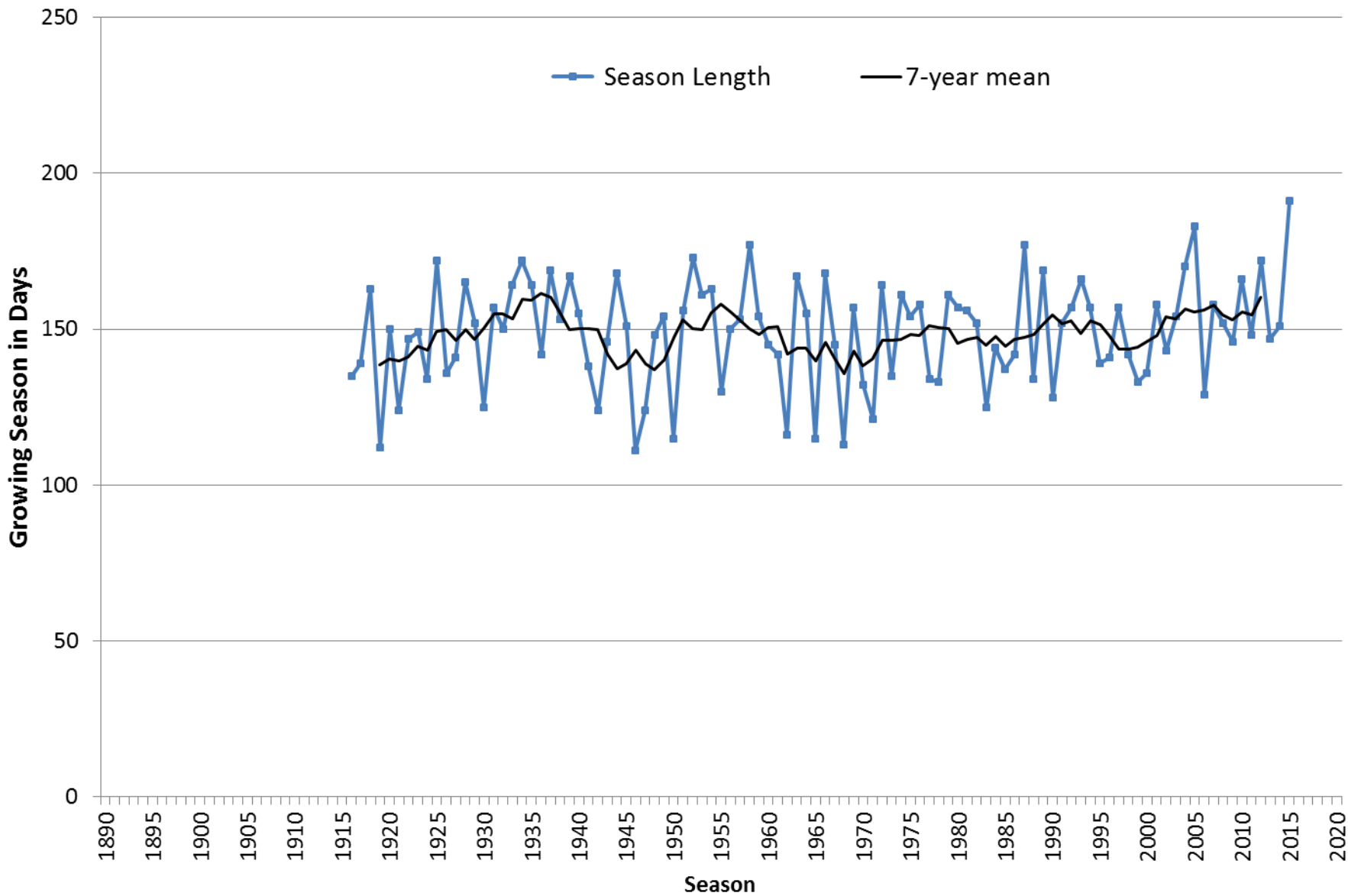
# Cheyenne Wells Growing Season Length using 32°F



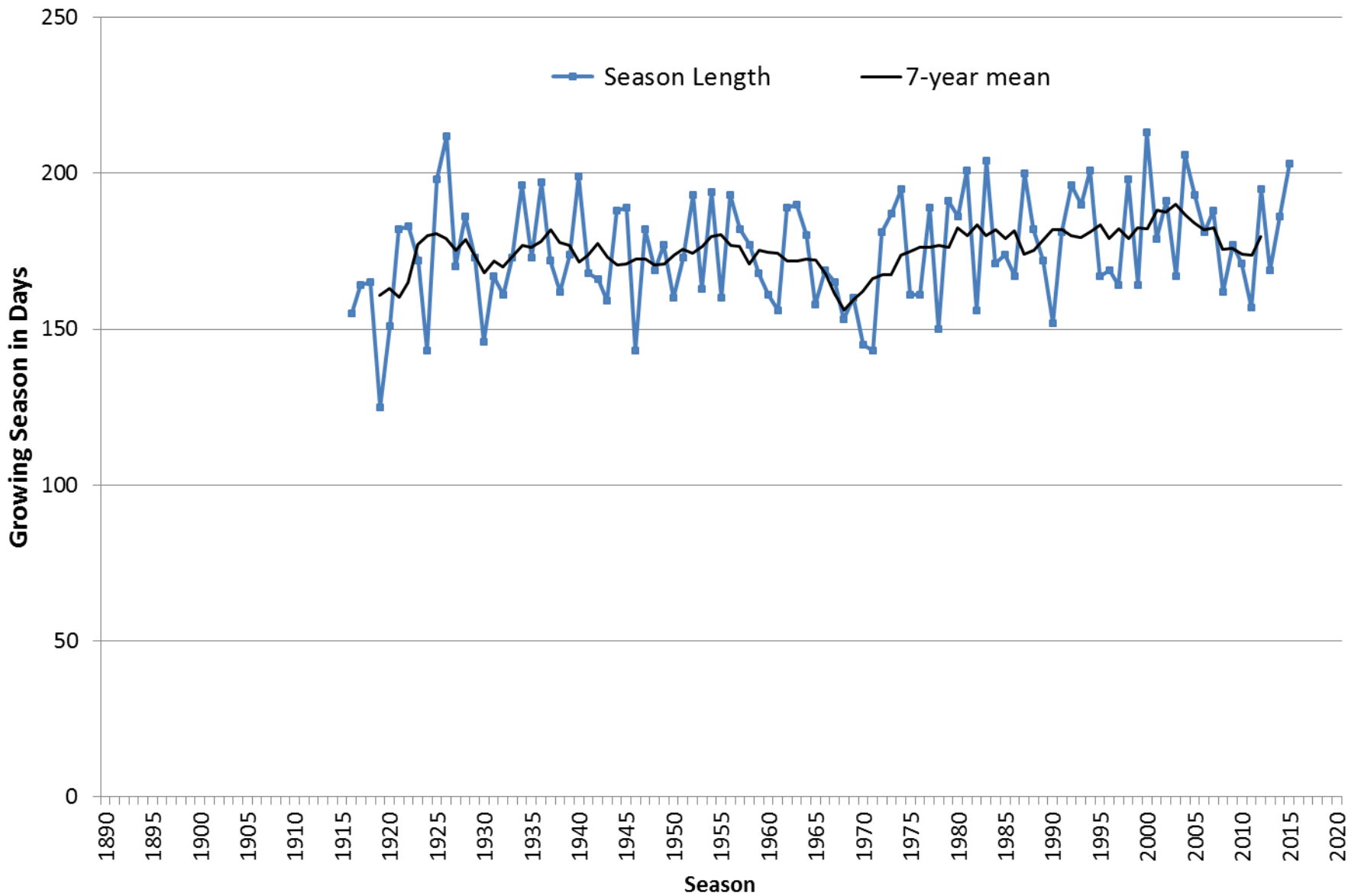
# Cheyenne Wells Growing Season Length using 28°F



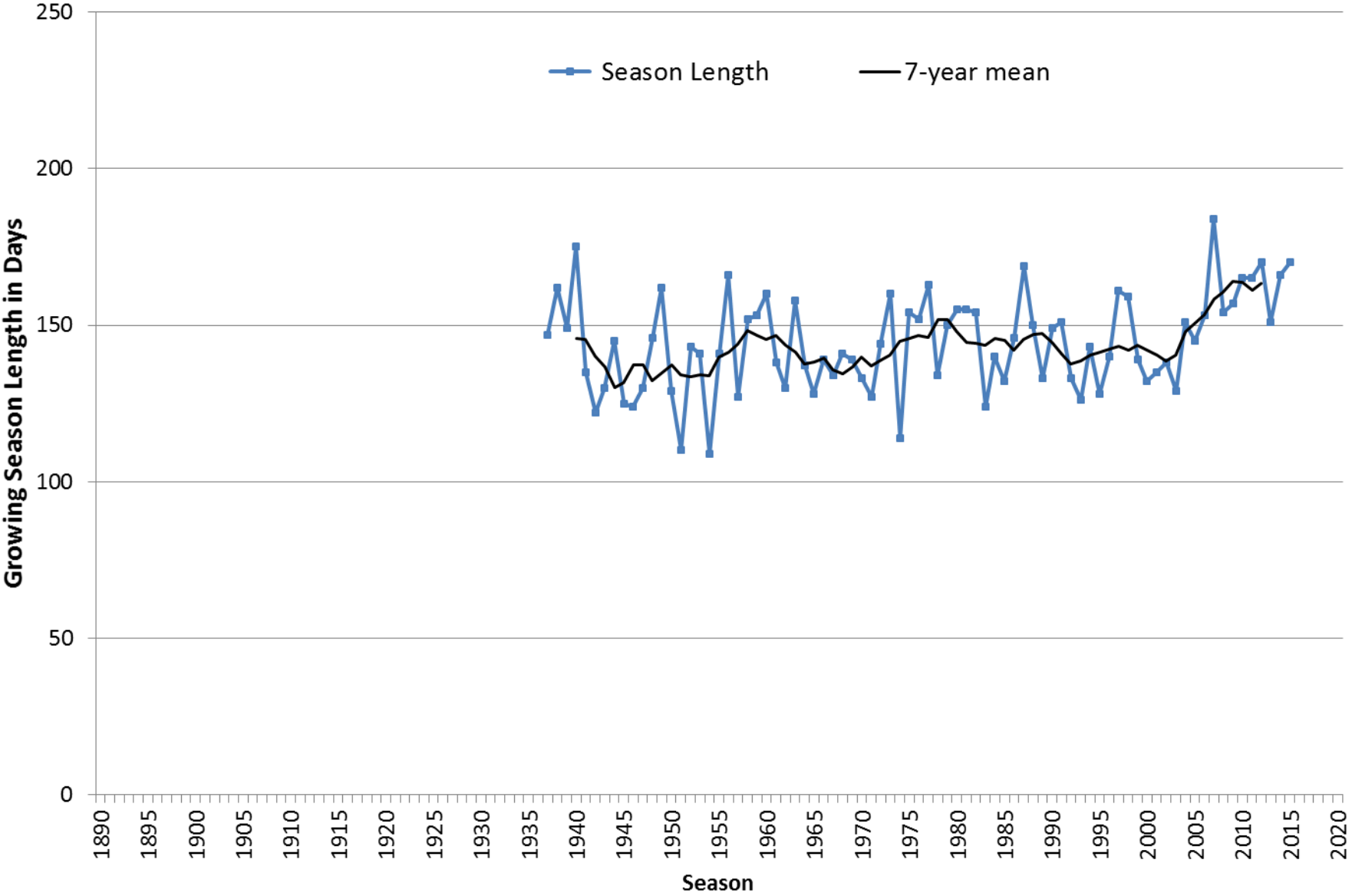
# Montrose Growing Season Length using 32°F



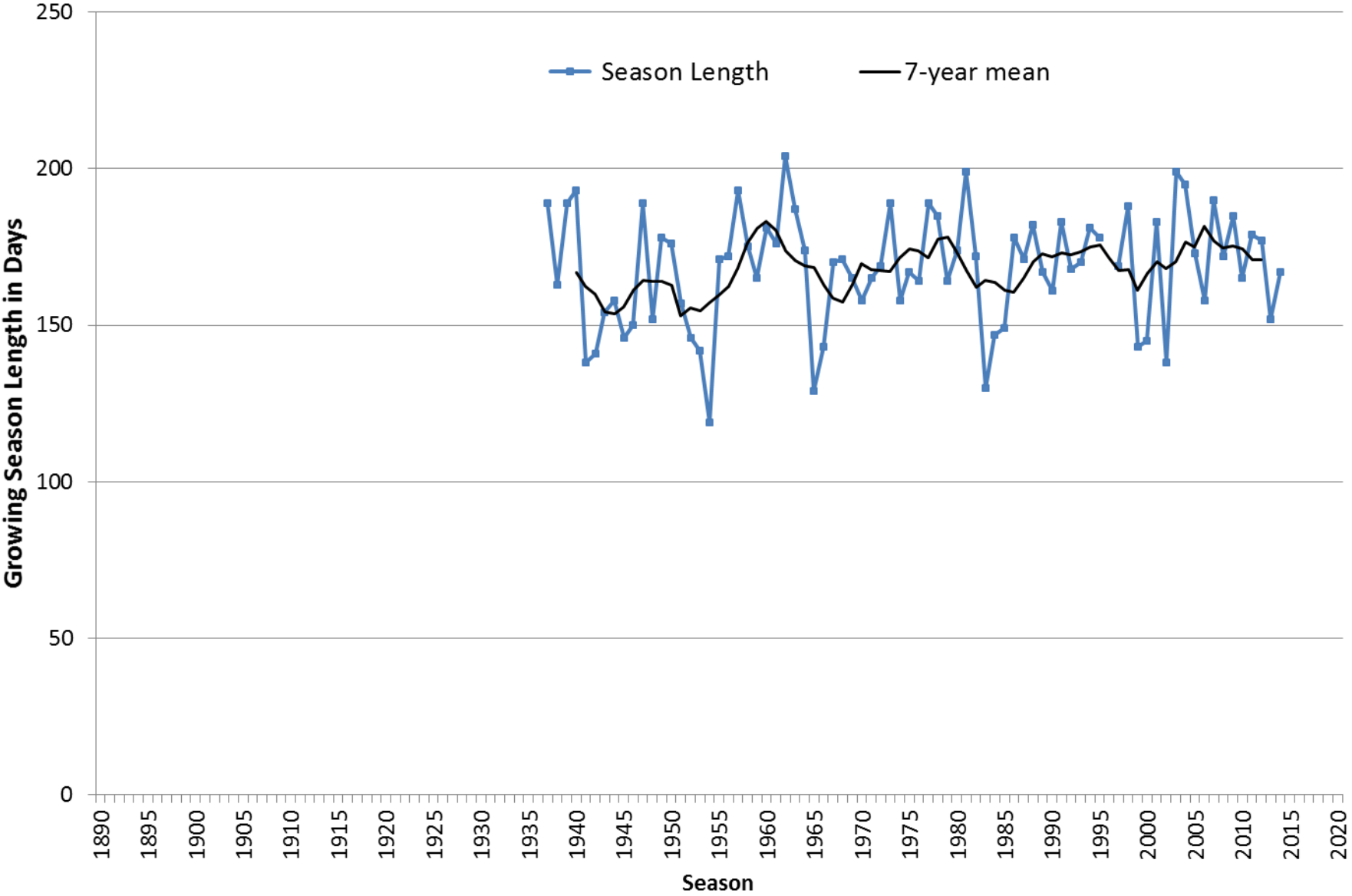
# Montrose Growing Season Length using 28°F



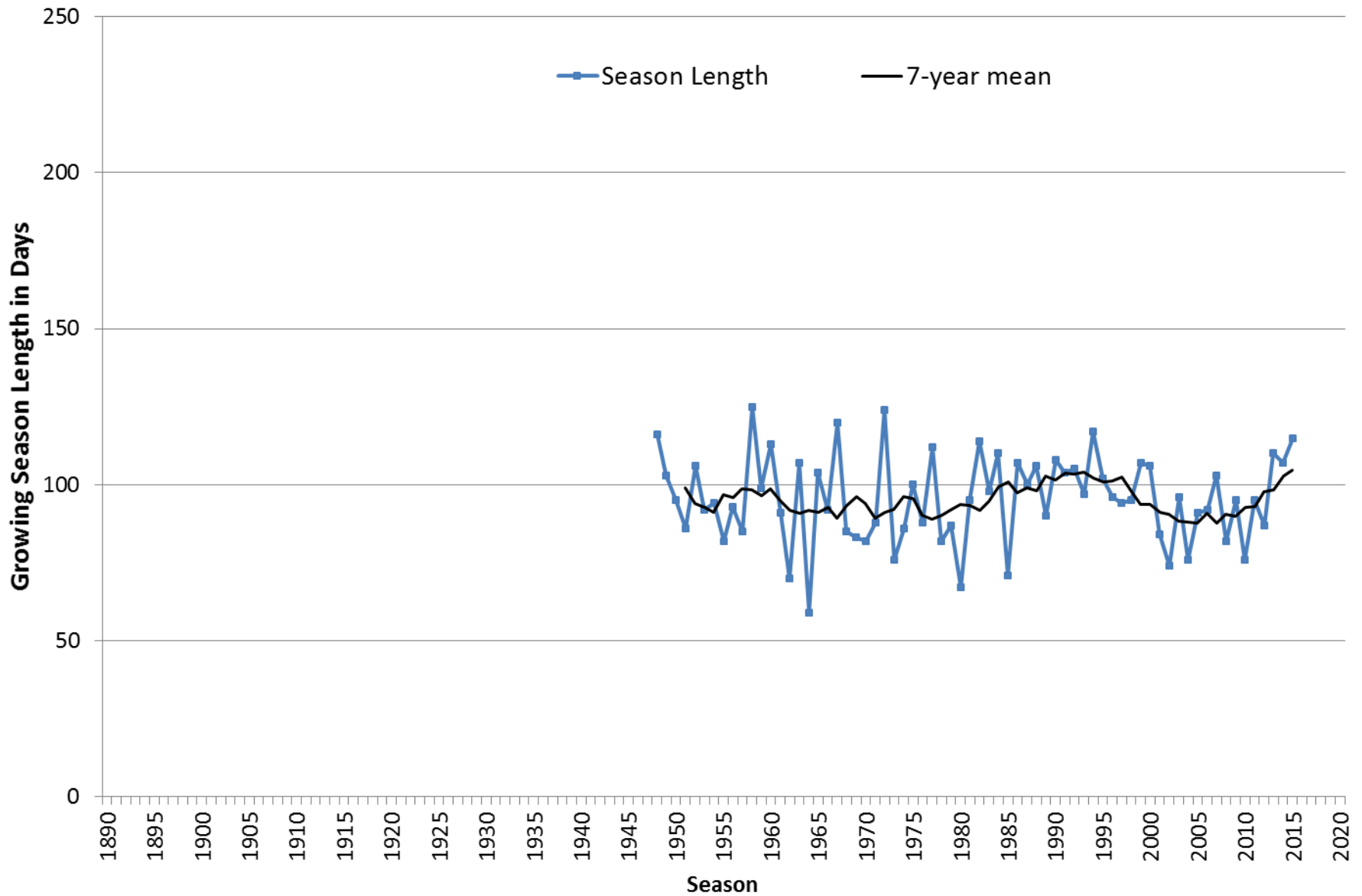
# Akron AP Growing Season Length using 32°F



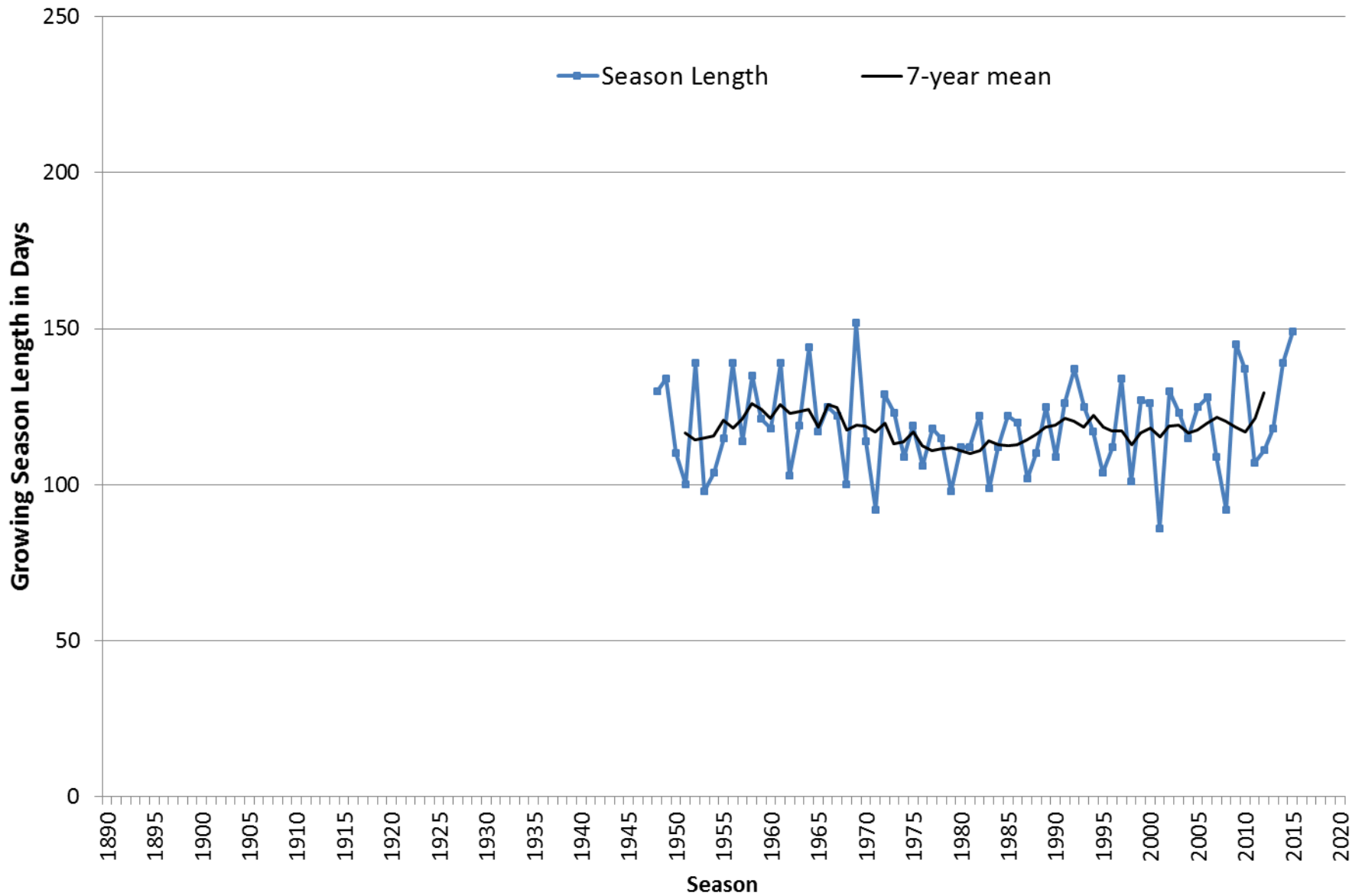
# Akron AP Growing Season Length using 28°F



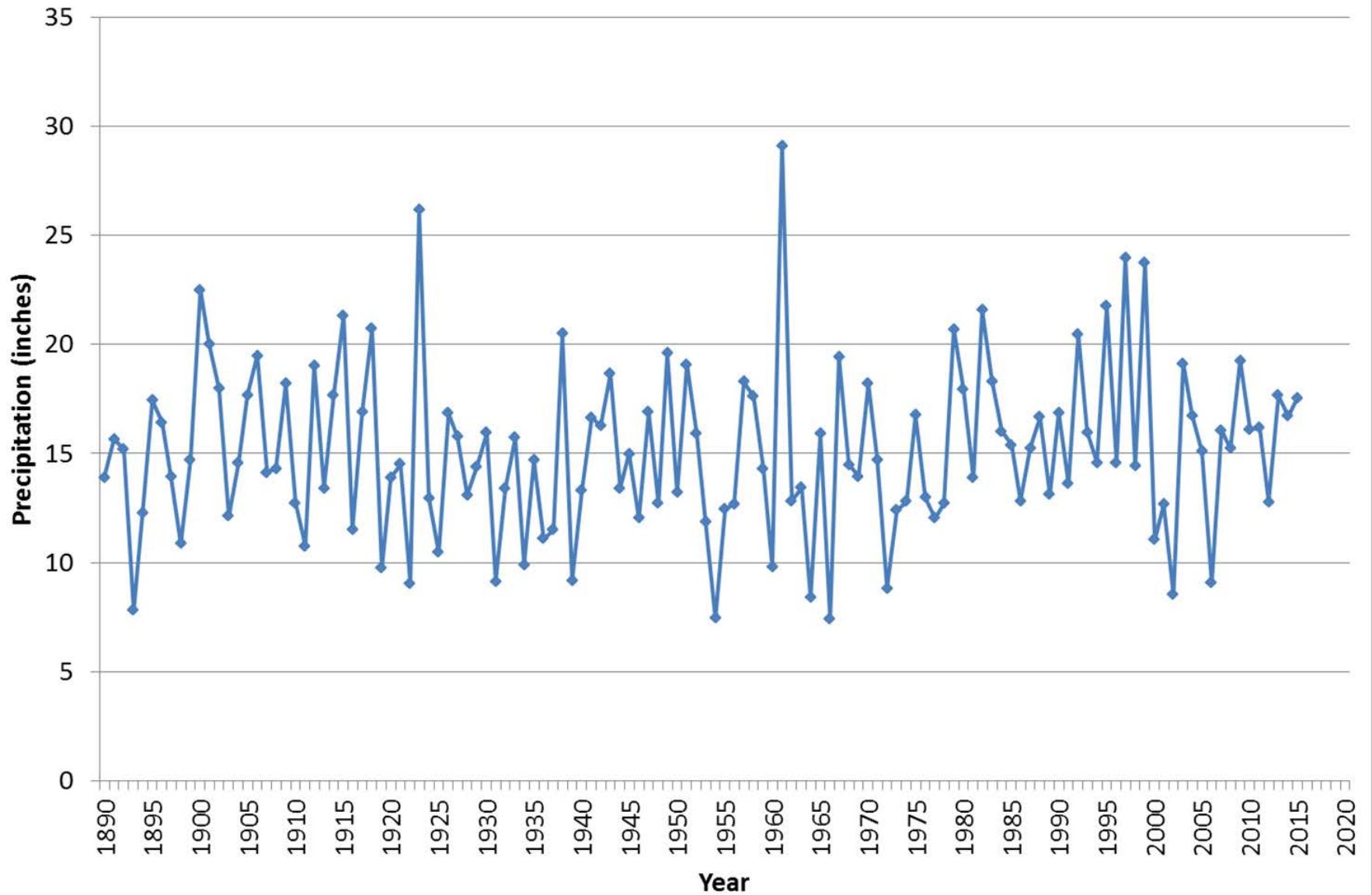
# Alamosa Growing Season Length using 32°F



# Alamosa Growing Season Length using 28°F

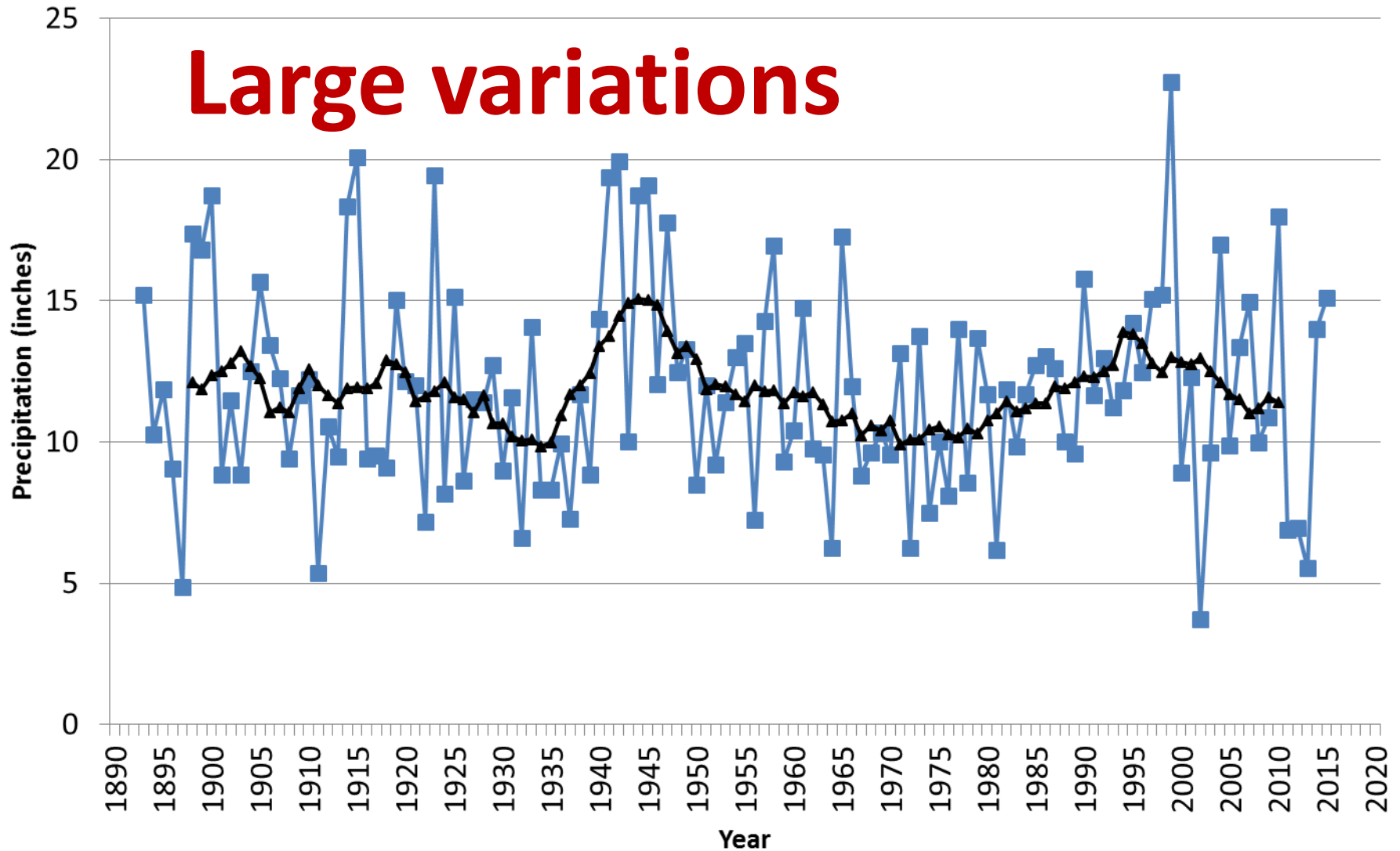


# Fort Collins, CO Water Year (Oct-Sep) Precipitation



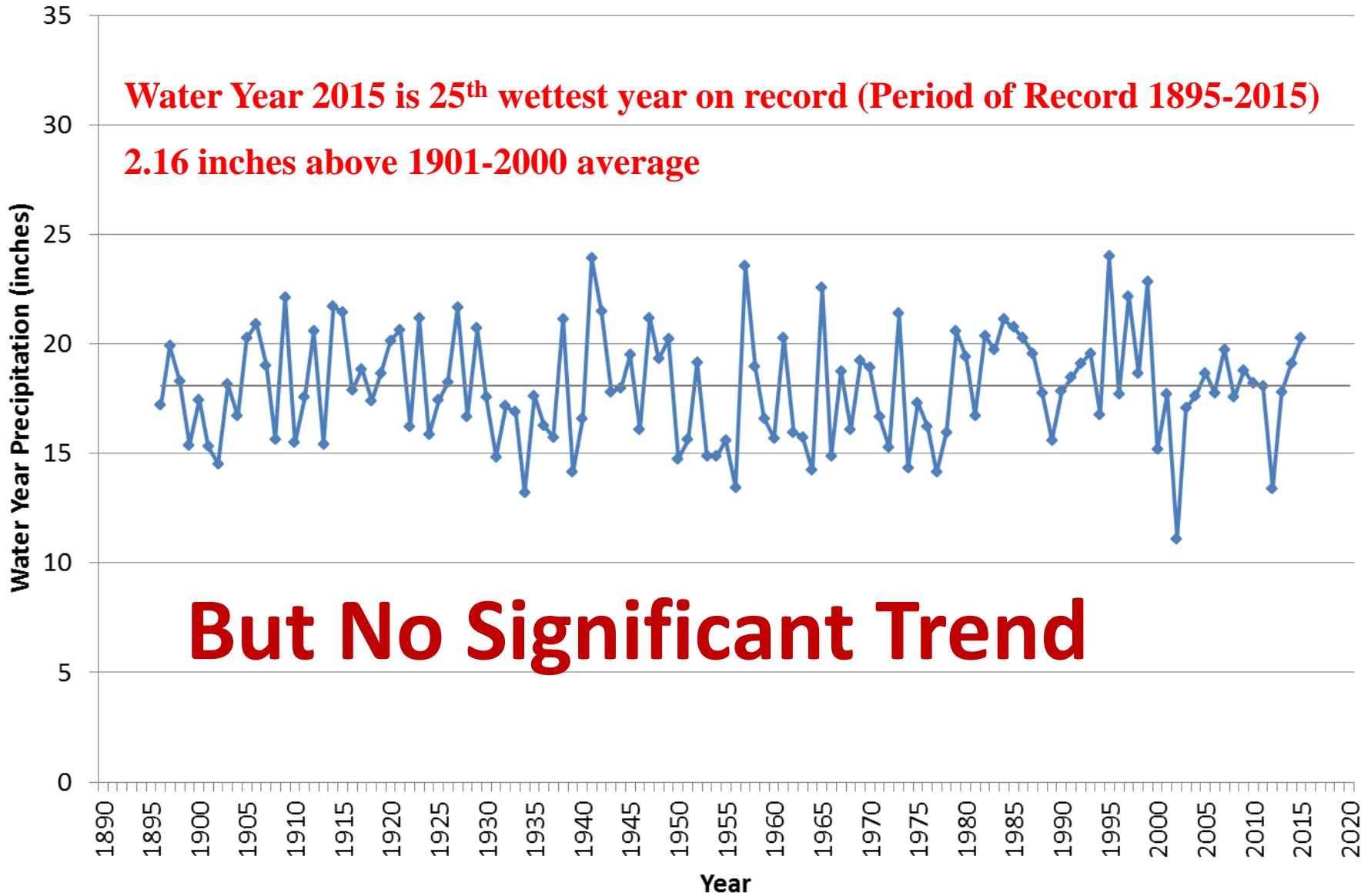
# Rocky Ford Water Year Precipitation with Running 11-Year Average

**Large variations**



# Colorado Precipitation in Historic Perspective

## Statewide Water Year Precipitation



**Thoughts about drought:  
We're all vulnerable  
Southern Colorado particularly prone**





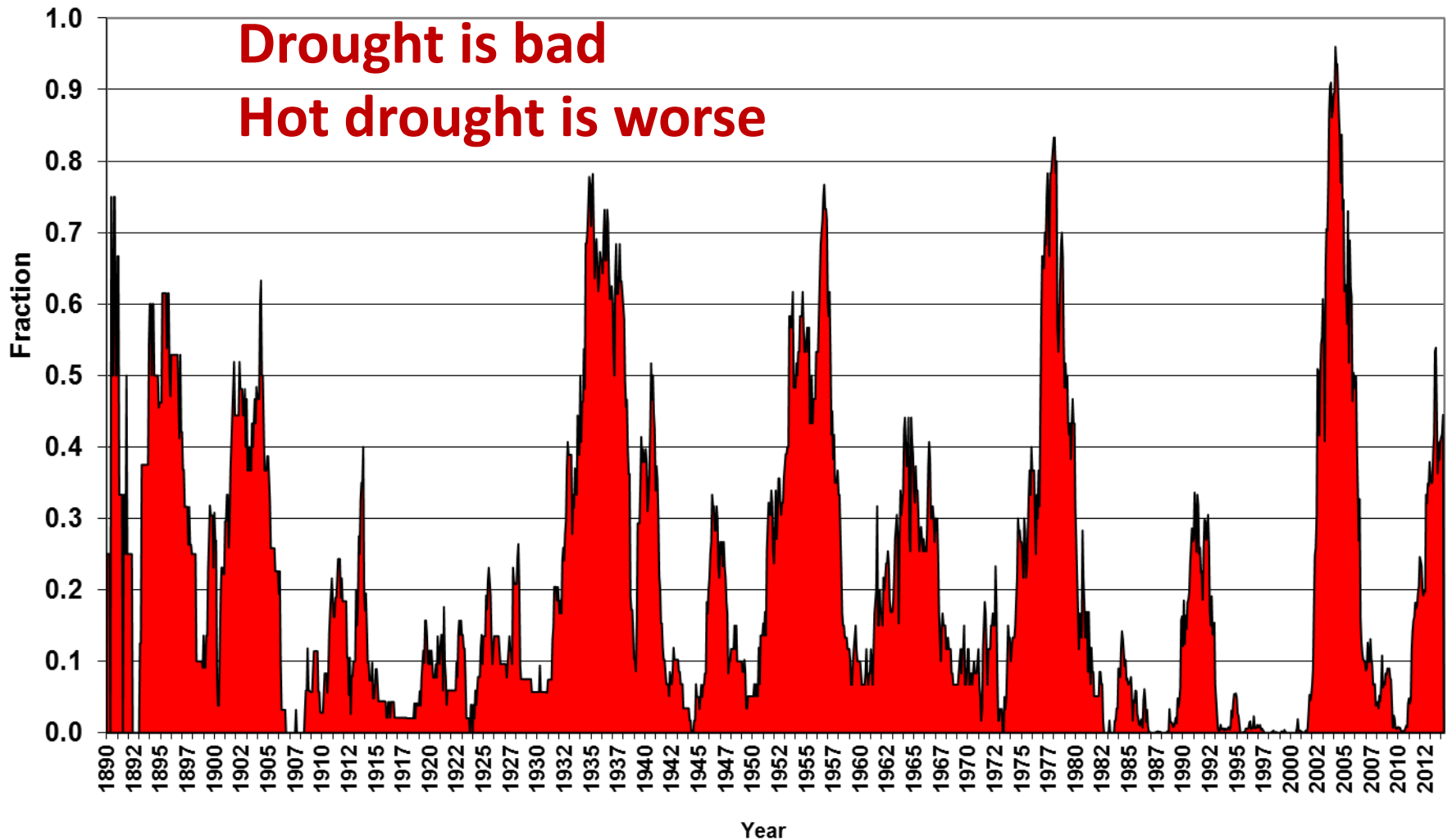
**Drought never leaves us  
alone for long**

Photo by Lyric Lucero  
2013 Manzanola, CO

# Fraction of Colorado in Drought

## Based on 48 month SPI (SPI <-1)

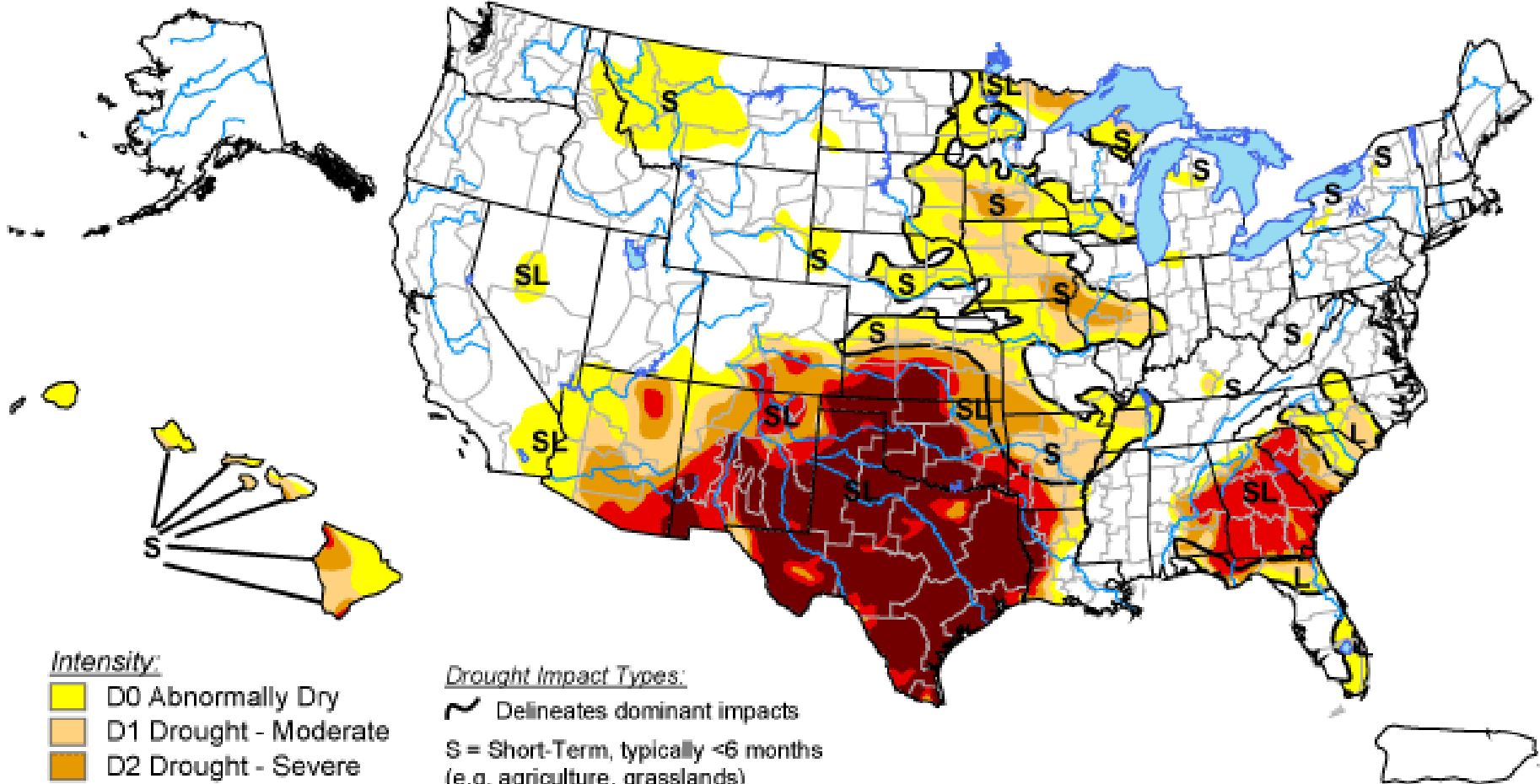
(1890 - March 2014)








# 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.

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



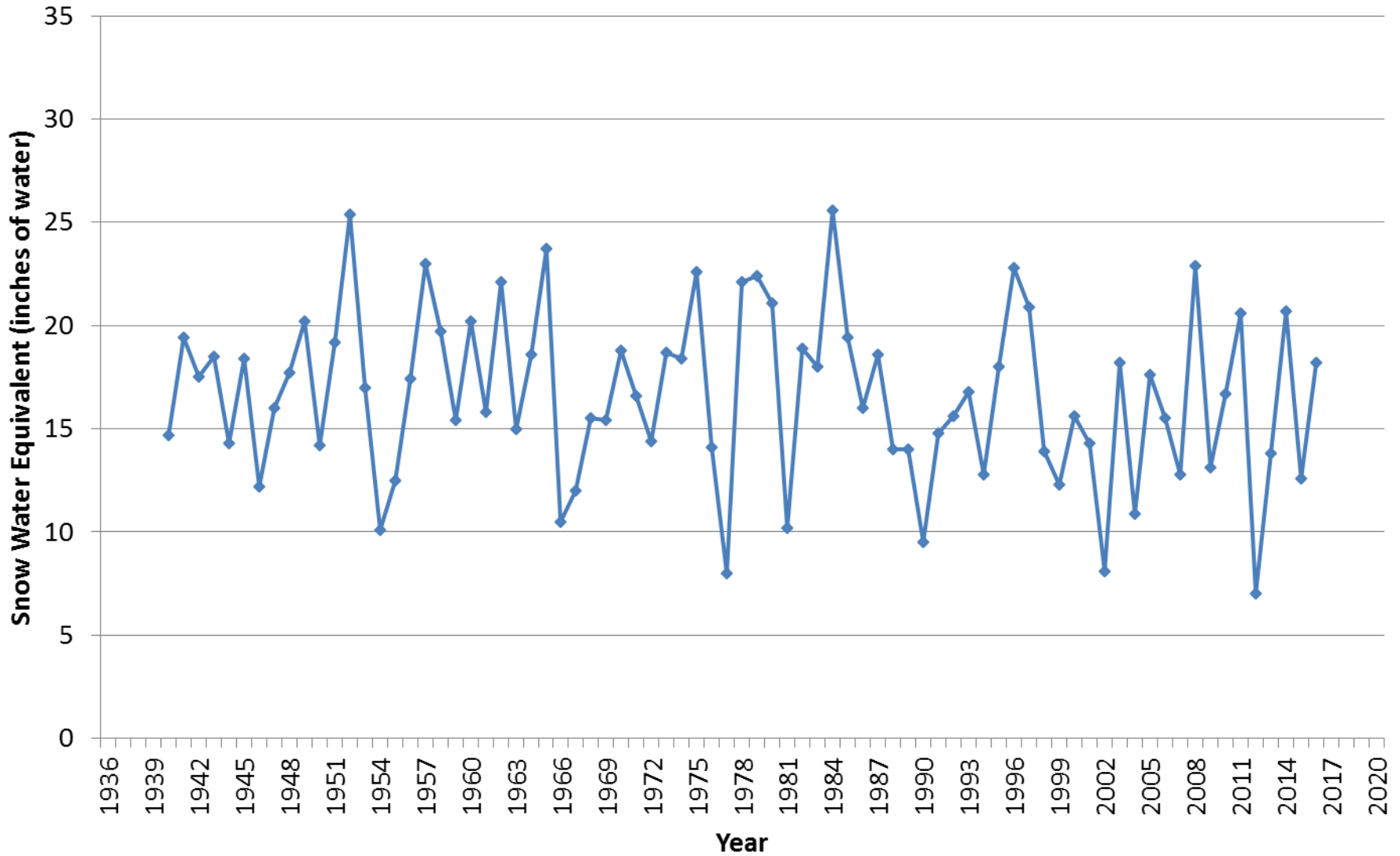
Released Thursday, October 6, 2011

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

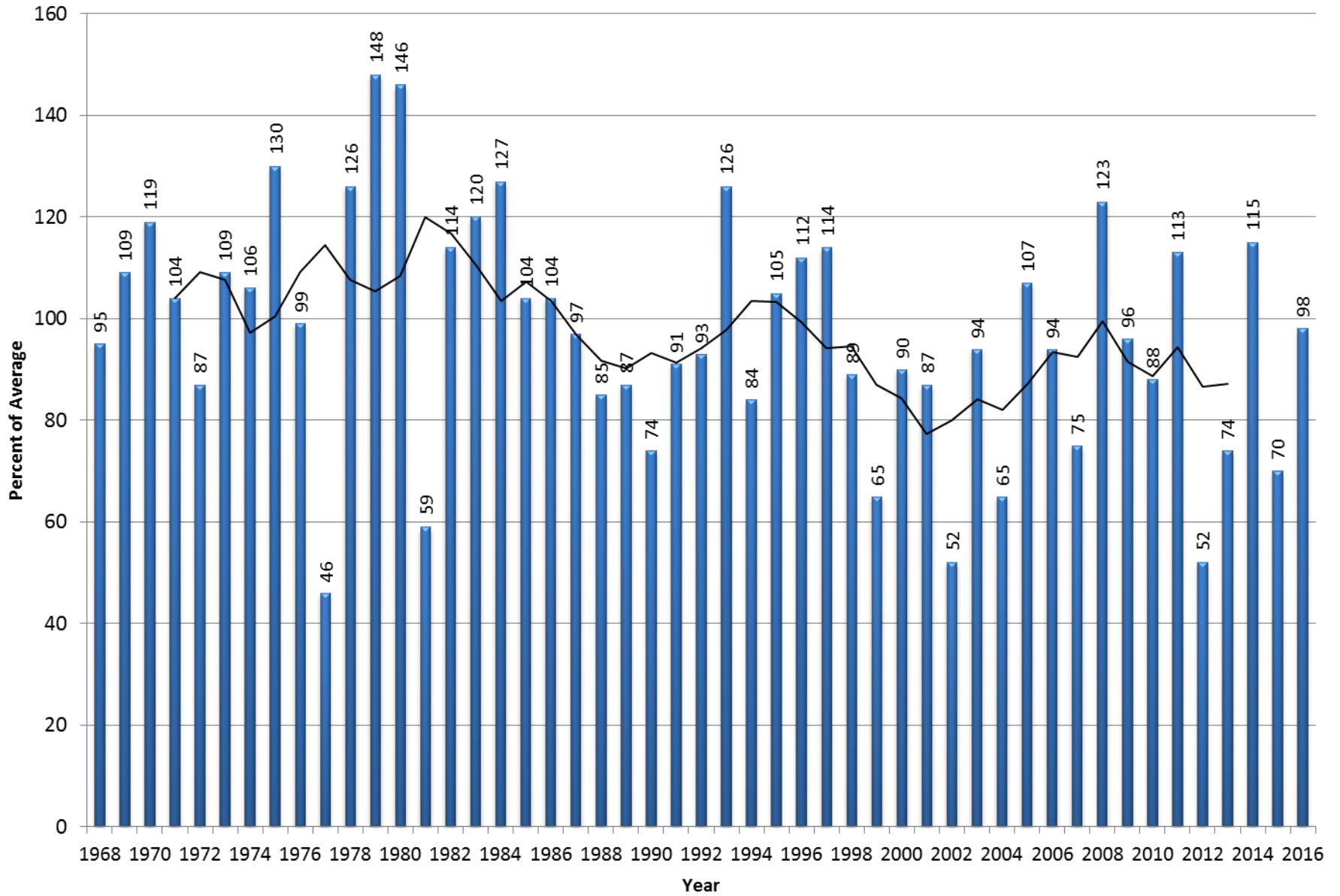
# What about our precious Snowpack?



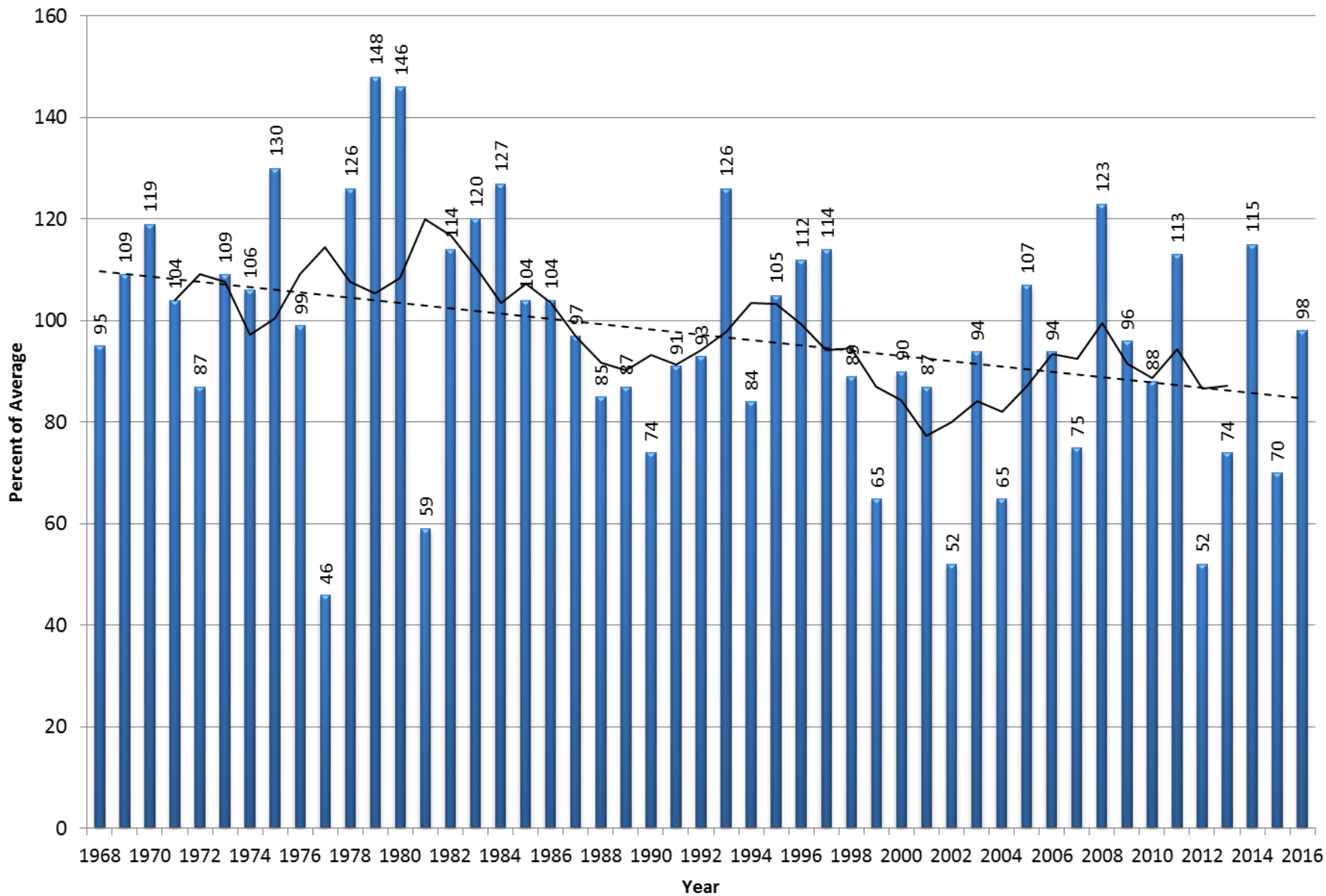
# Porphyry Creek Snow Course April 1 Snow Water Equivalent



# April 1 Colorado Statewide Snowpack

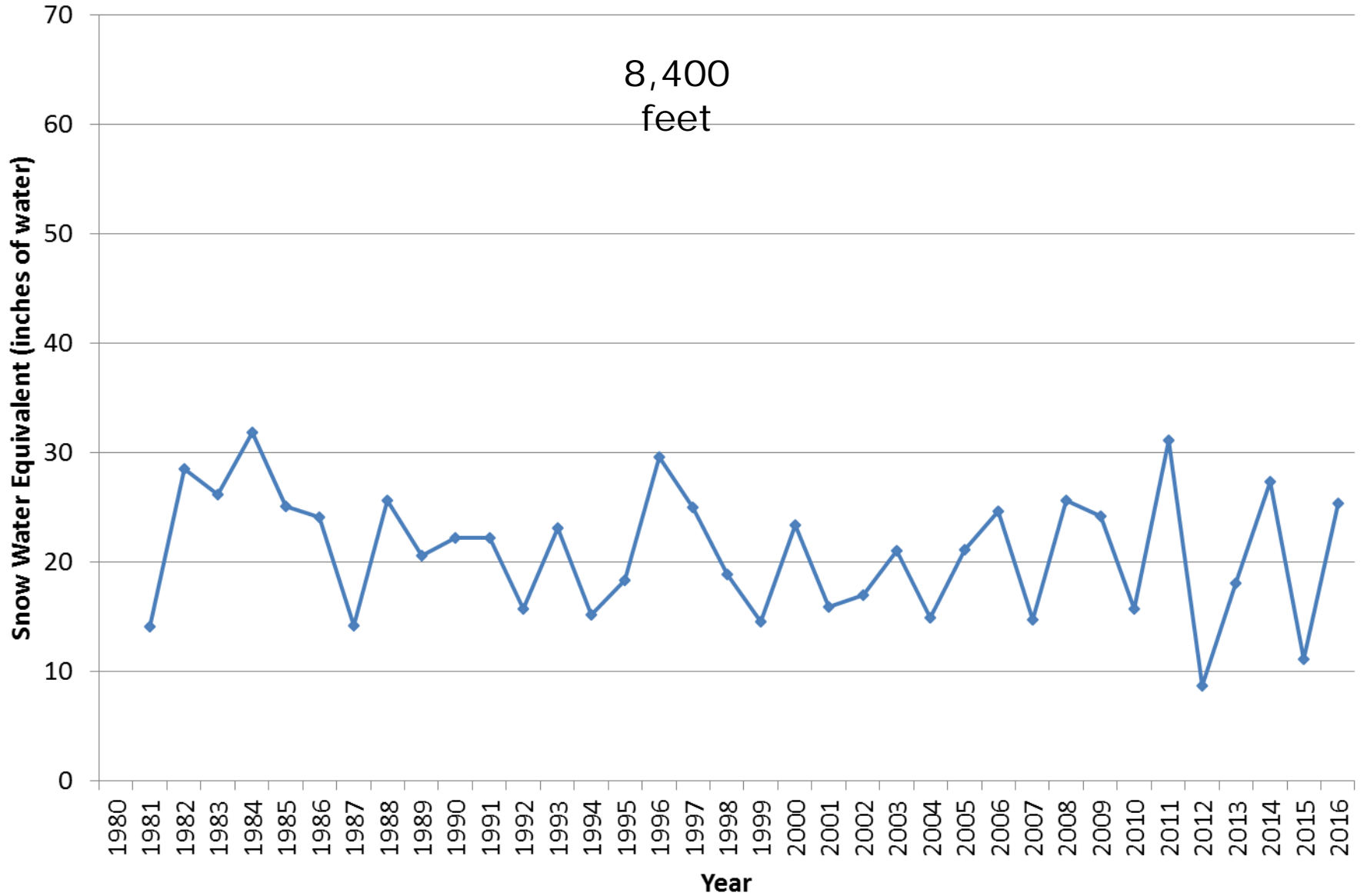


# April 1 Colorado Statewide Snowpack

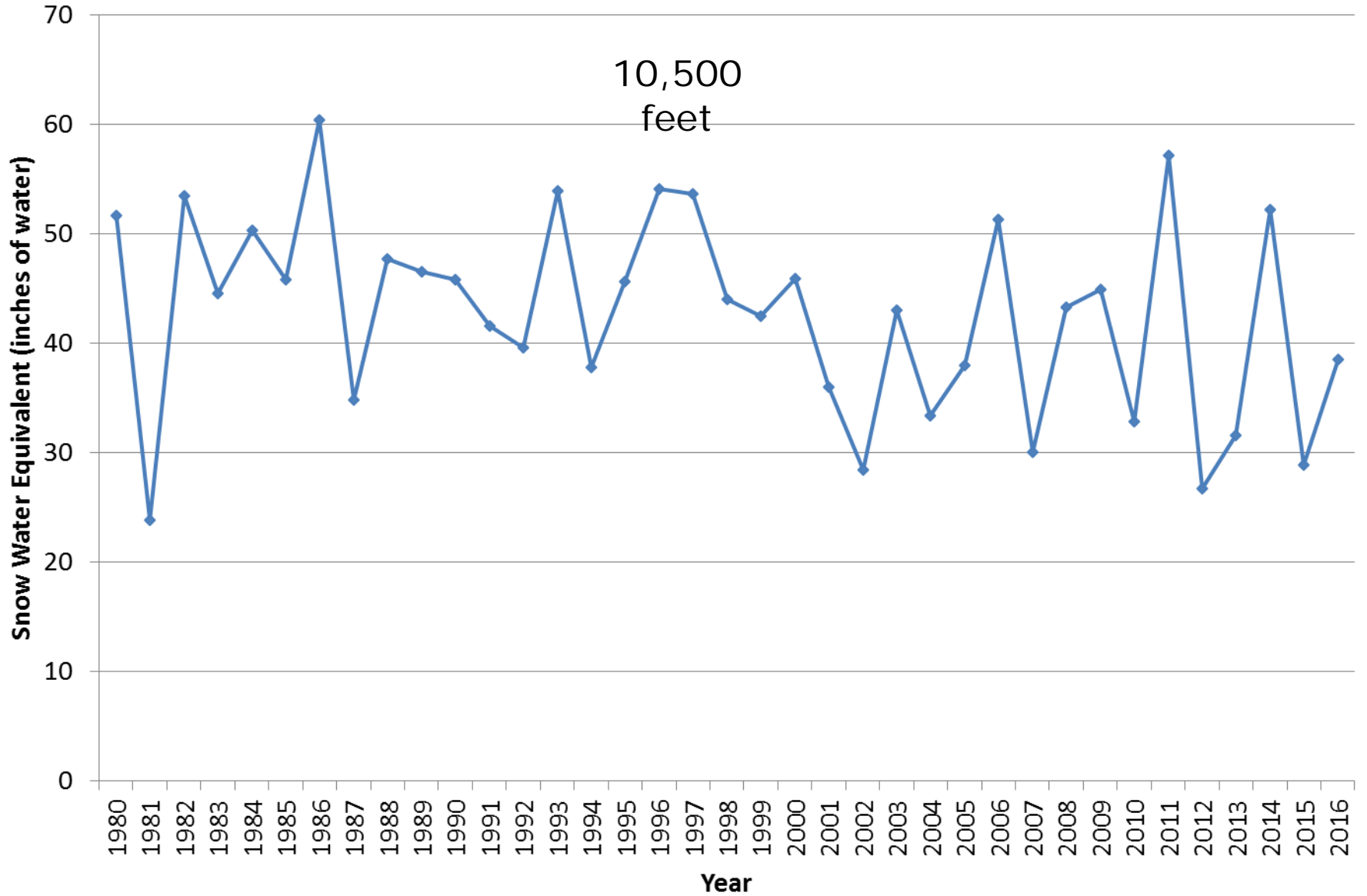


# Dry Lake SNOTEL April 1 Snow Water Equivalent (in)

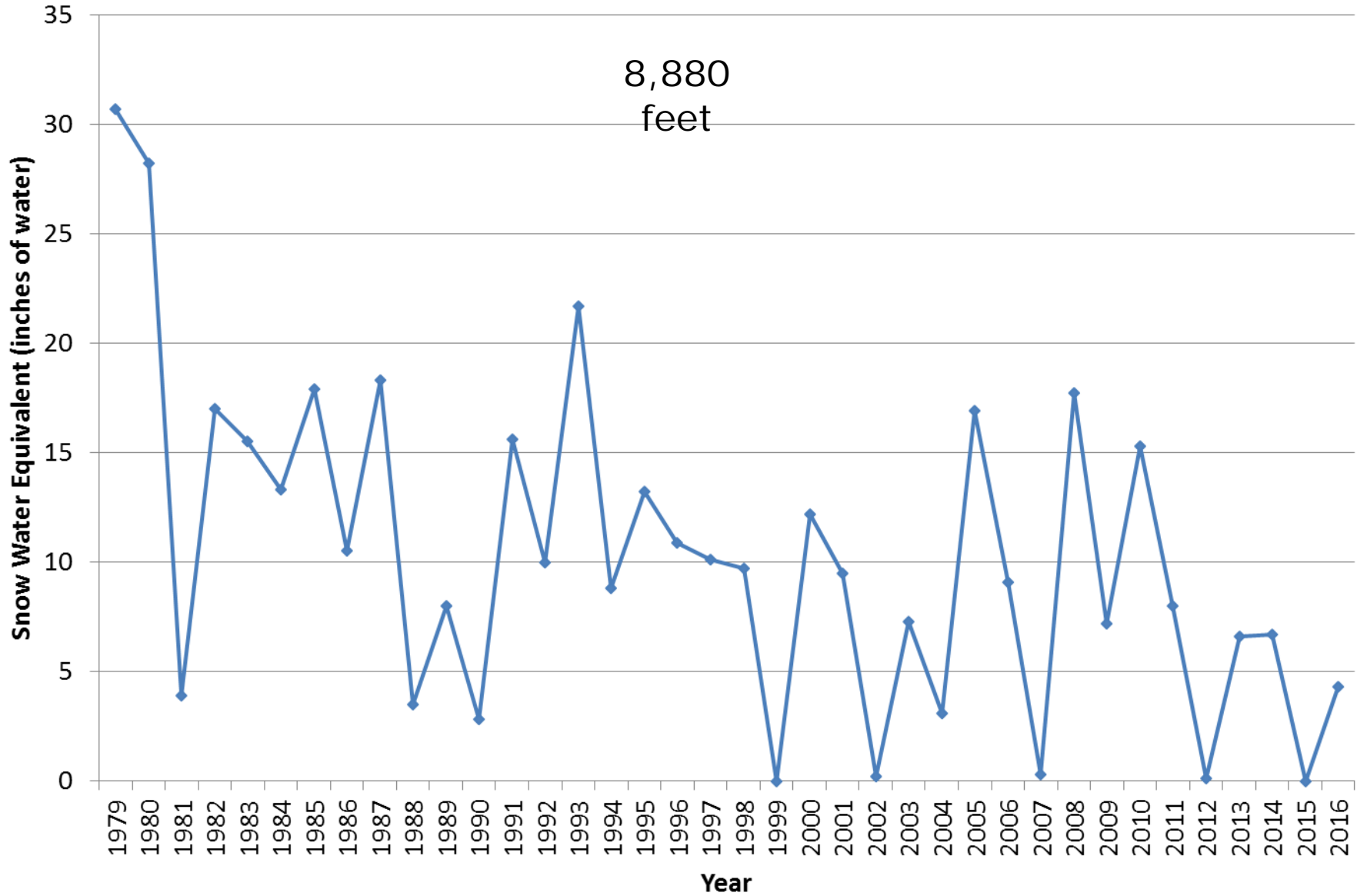
8,400  
feet



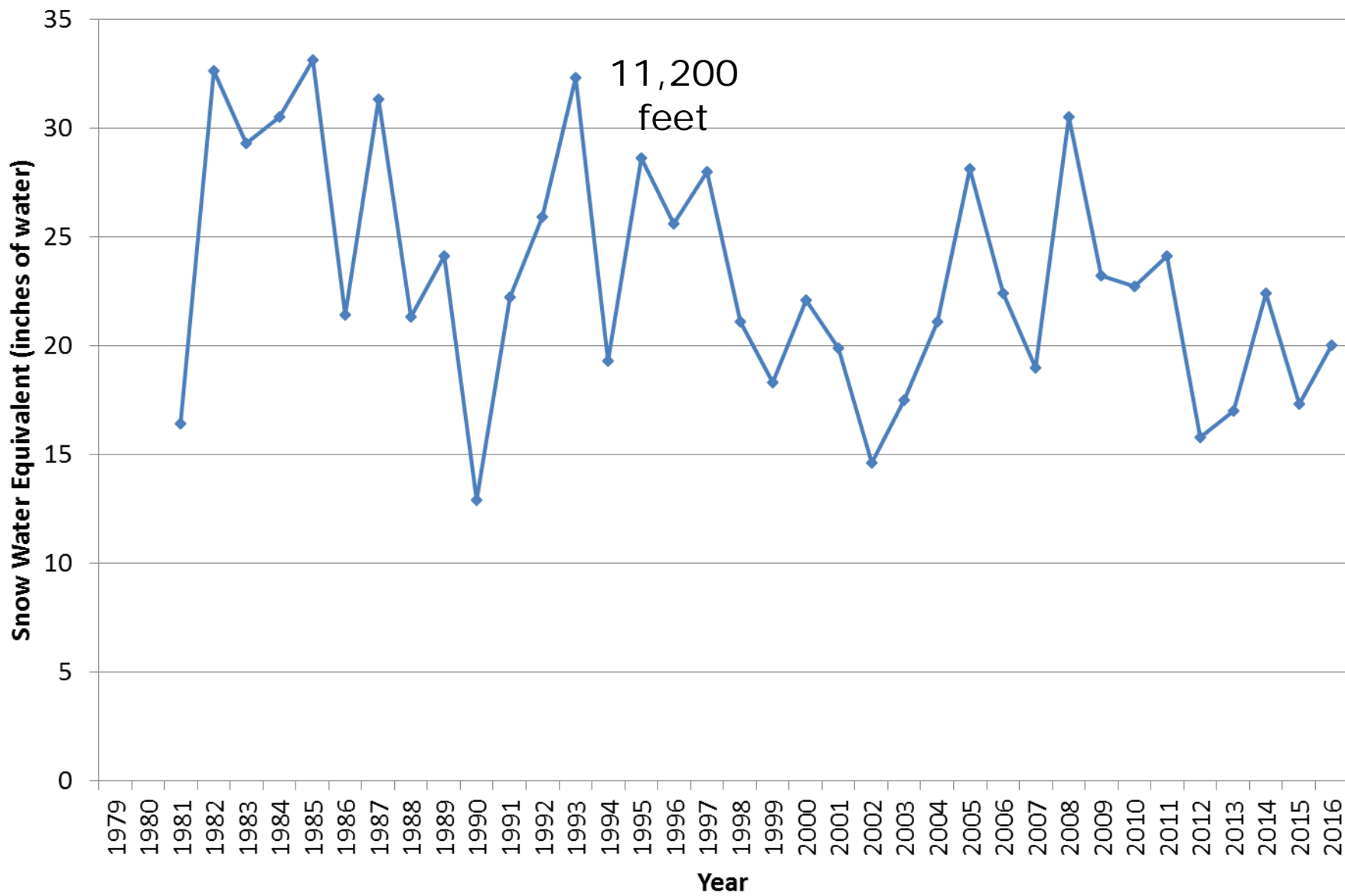
# Tower SNOTEL April 1 Snow Water Equivalent (in)



# Cascade SNOTEL April 1 Snow Water Equivalent (in)



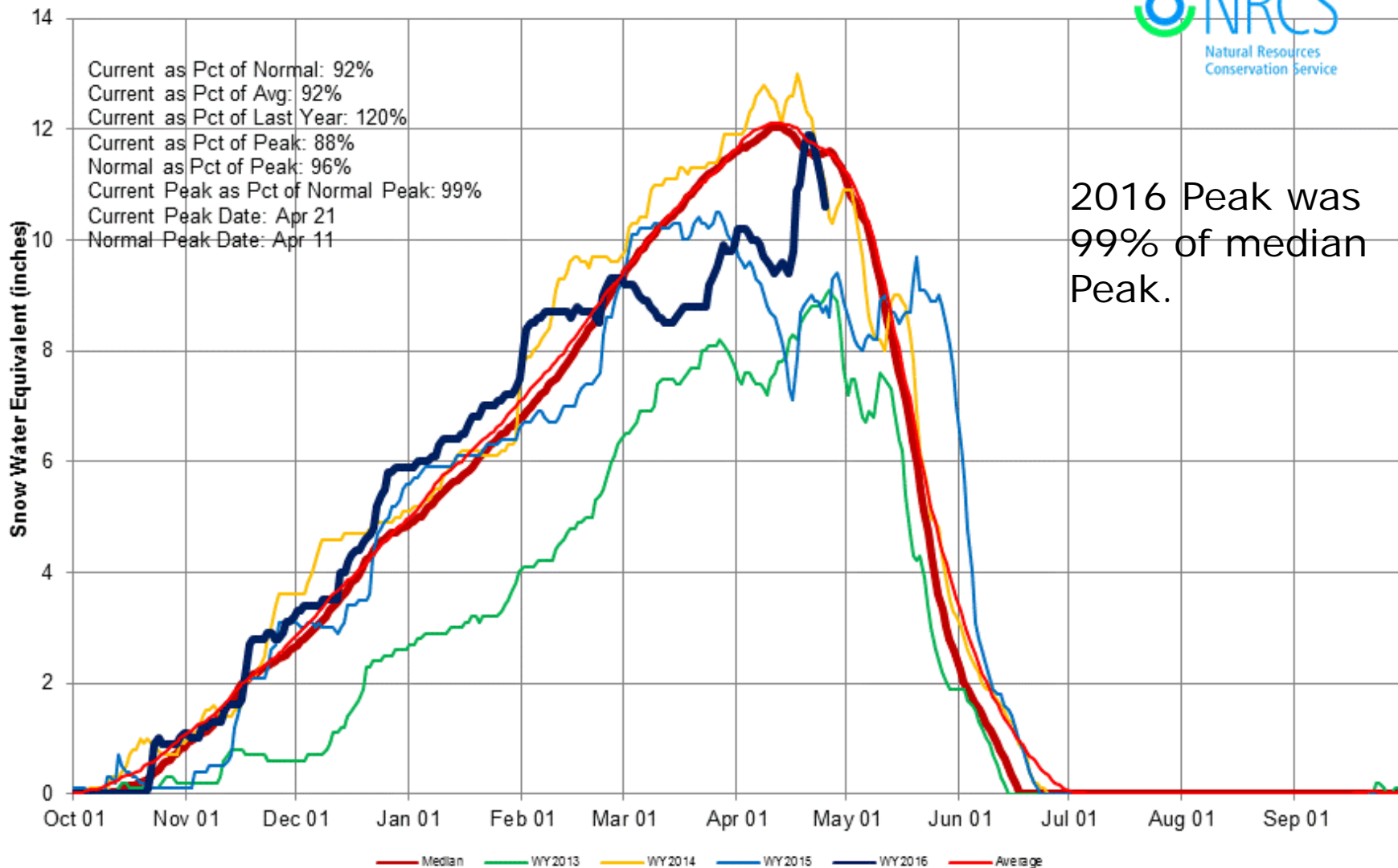
# Red Mountain Pass April 1 Snow Water Equivalent (in)



# Too many years lately at or below the long-term average

## Arkansas River Basin Time Series Snowpack Summary

Based on Provisional SNOTEL data as of Apr 25, 2016



# Summary

- Temperatures in Colorado are warming, especially since 1980
- More really warm days, fewer really cold days
- Trends in Colorado are similar to U.S and Globe
- Growing season longer but irregular
- No significant trends in precipitation yet
- Hotter droughts
- April 1 snowpack declining

**If you see a double double,  
believe it**



Photo by Lynn Kral, Loveland, January 2006

# Weekly Climate Updates Available Upper Colorado Regional Drought Early Warning

