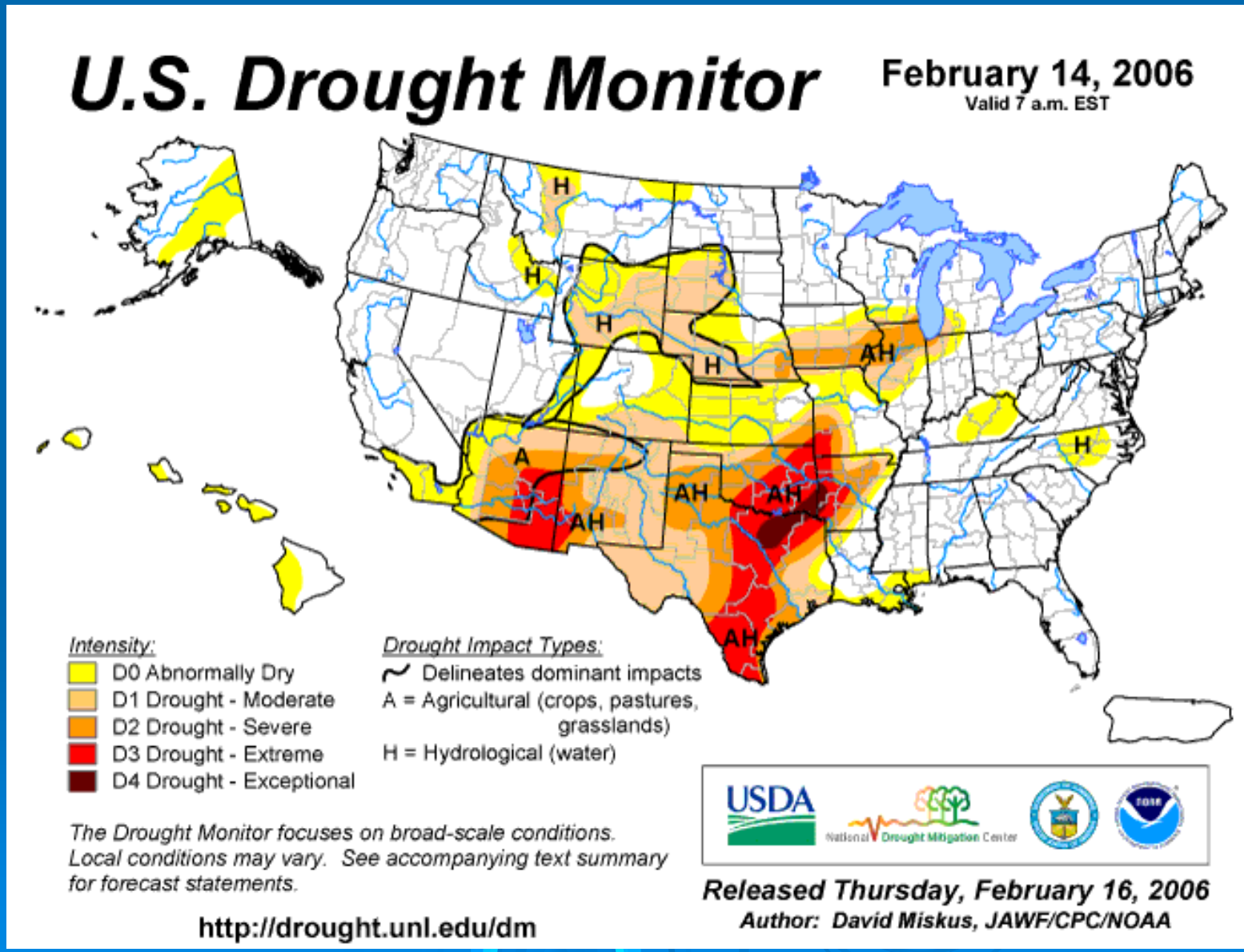
Drought and the Climate of the Ogallala Aquifer

Nolan J. Doesken
Colorado Climate Center
Colorado State University

Presented at Ogallala Symposium, Wray, Colorado
February 20, 2006
Prepared by Odie Bliss

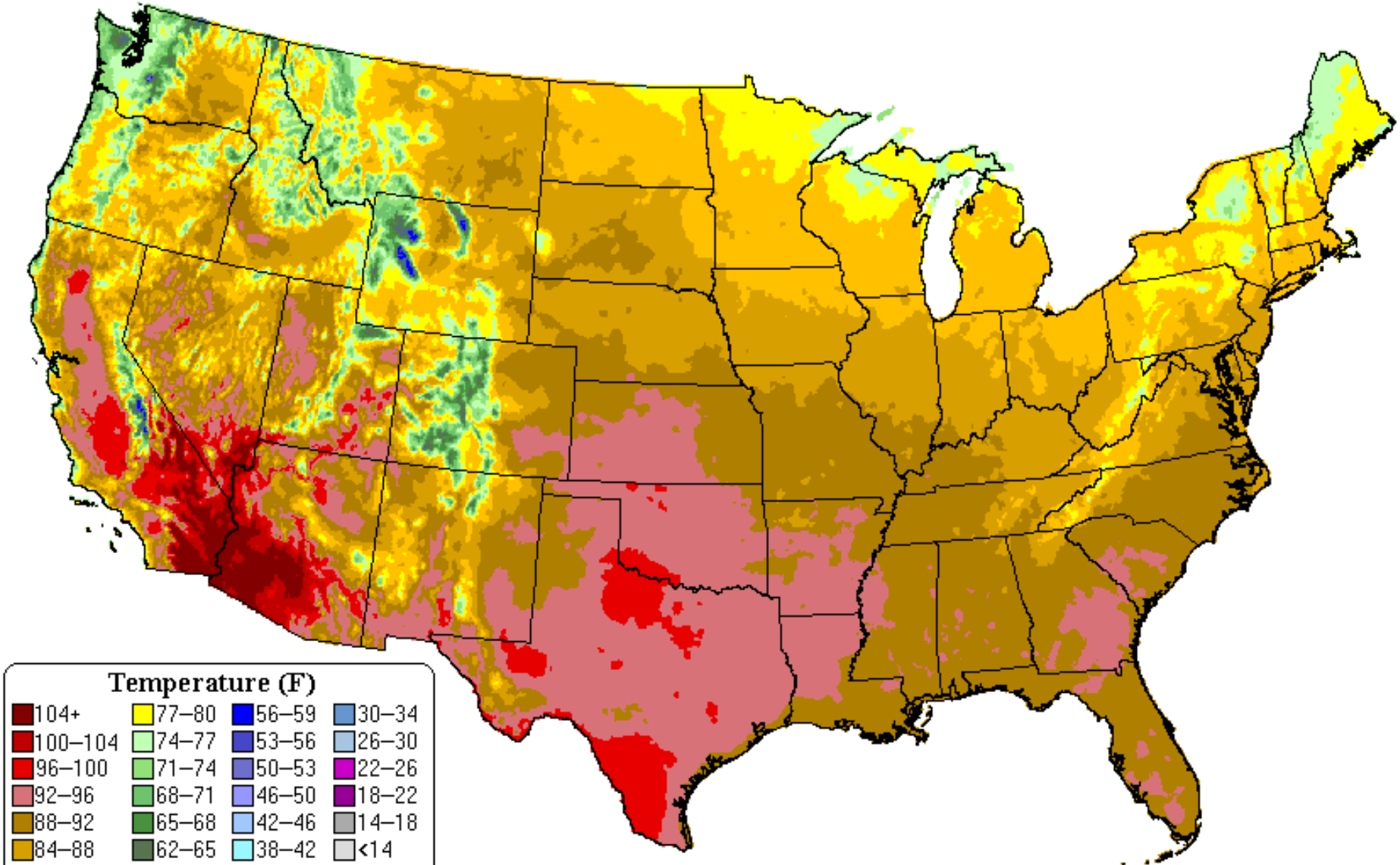
Colorado State University
Knowledge to Go Places

Drought Monitor Map



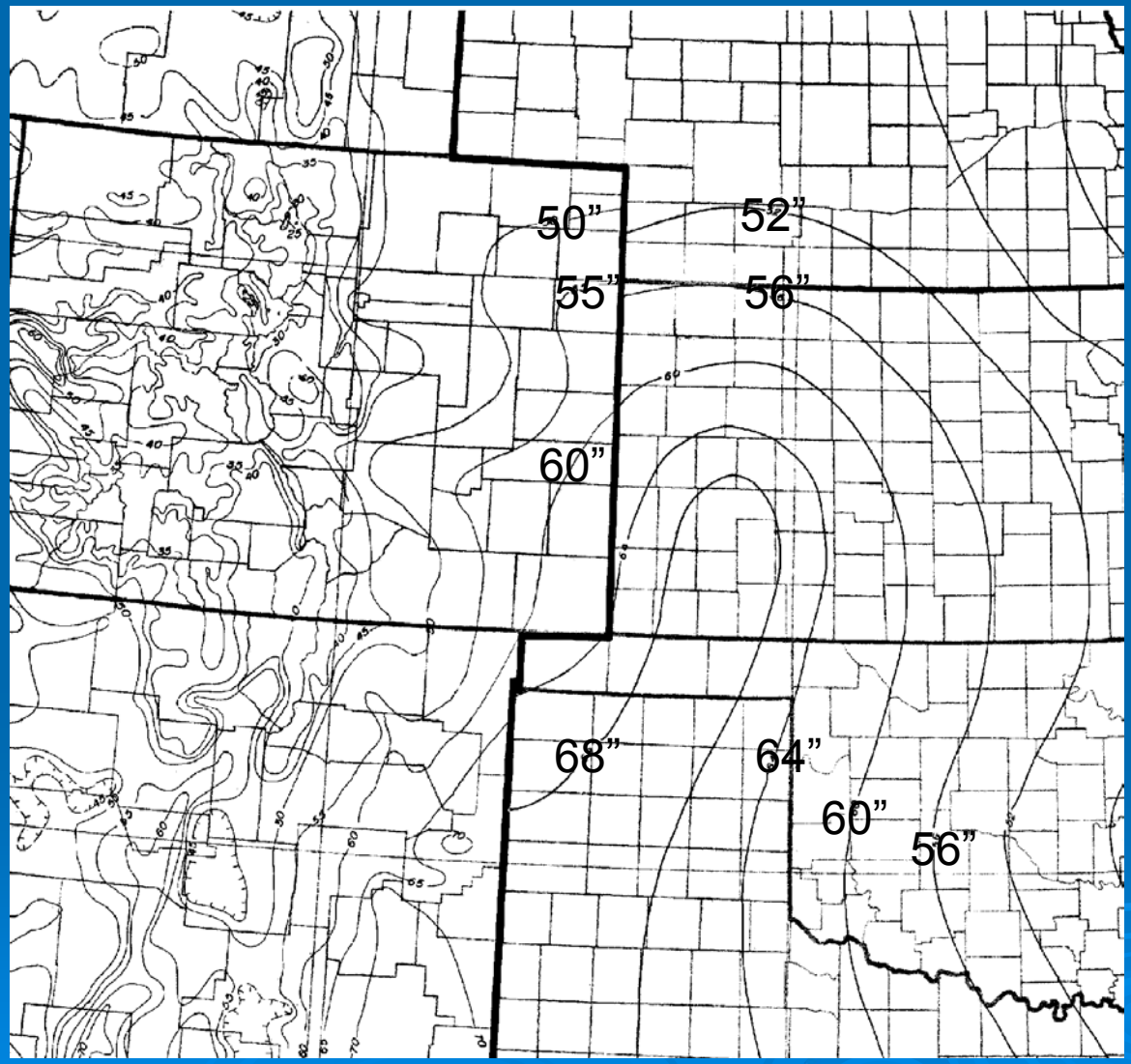
But what does this mean?
We need some perspective.

Maximum Temperature: July Climatology (1971–2000)



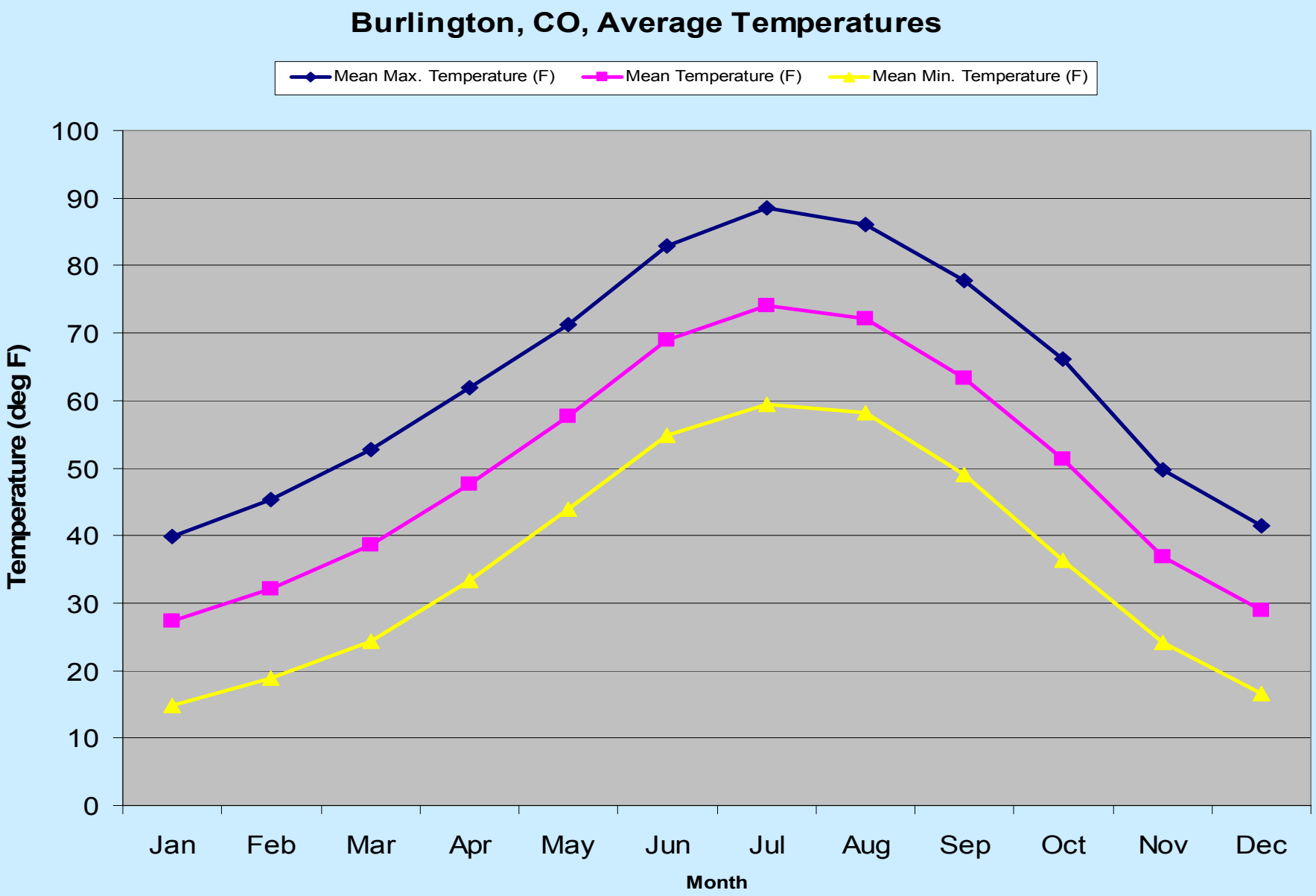
Copyright (c) 2004, Spatial Climate Analysis Service, Oregon State University
http://www.ocs.oregonstate.edu/prism – Map created Feb 20 2004

Class A Pan Evaporation (May-Oct)

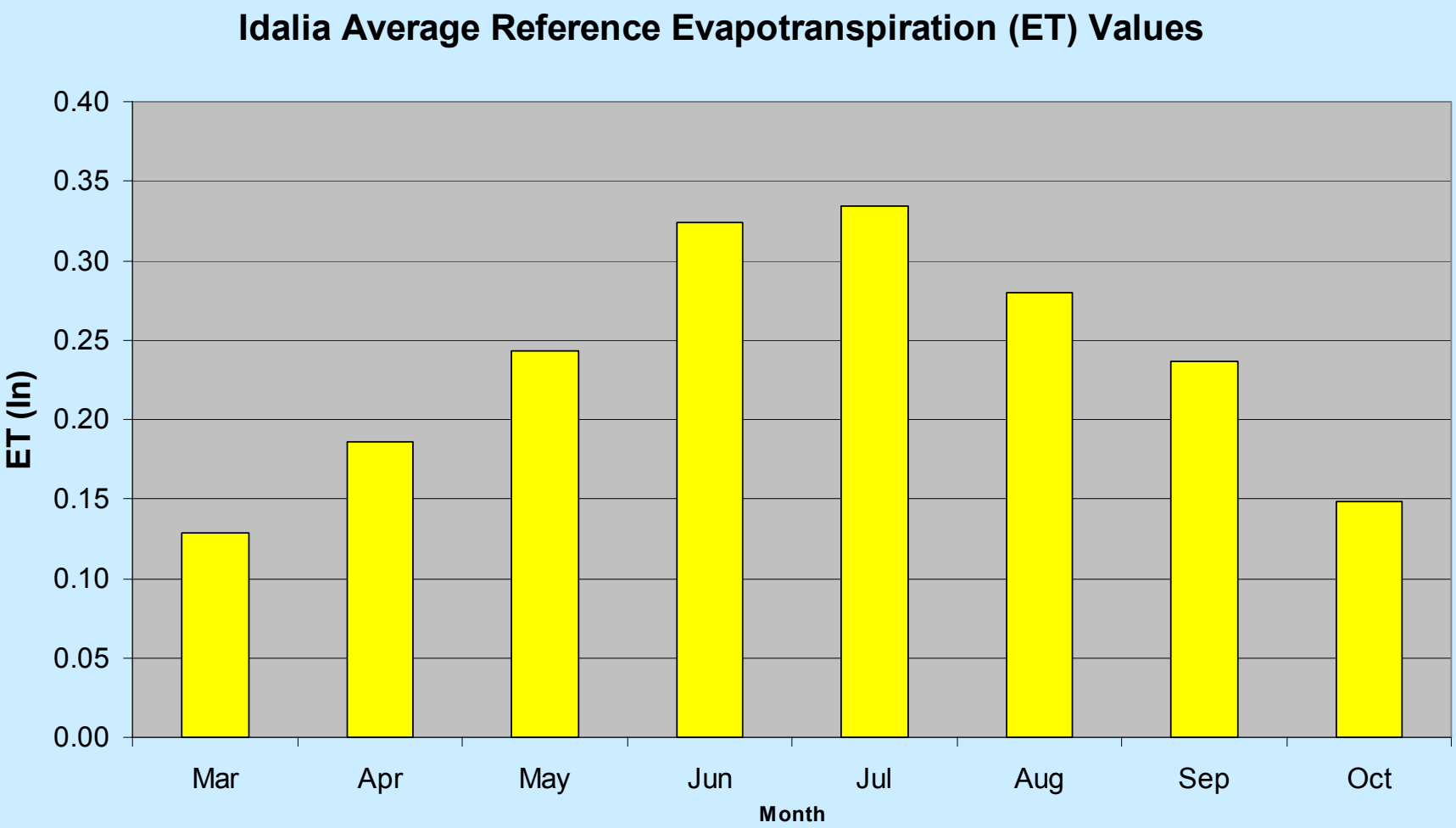


From NOAA Tech Report NWS 33

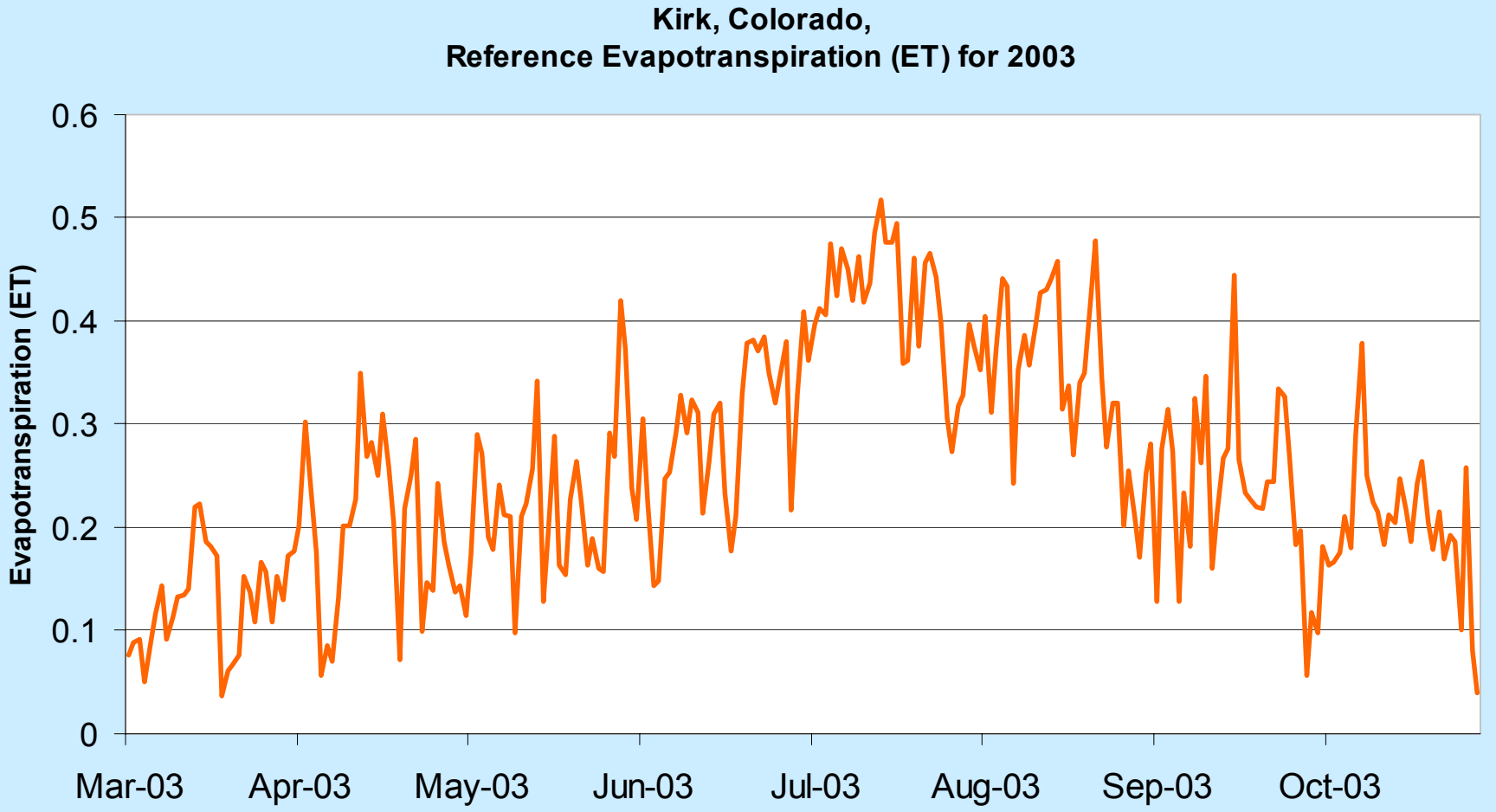
Burlington Temperatures



Idalia CoAgMet Reference Evaportranspiration (ET)

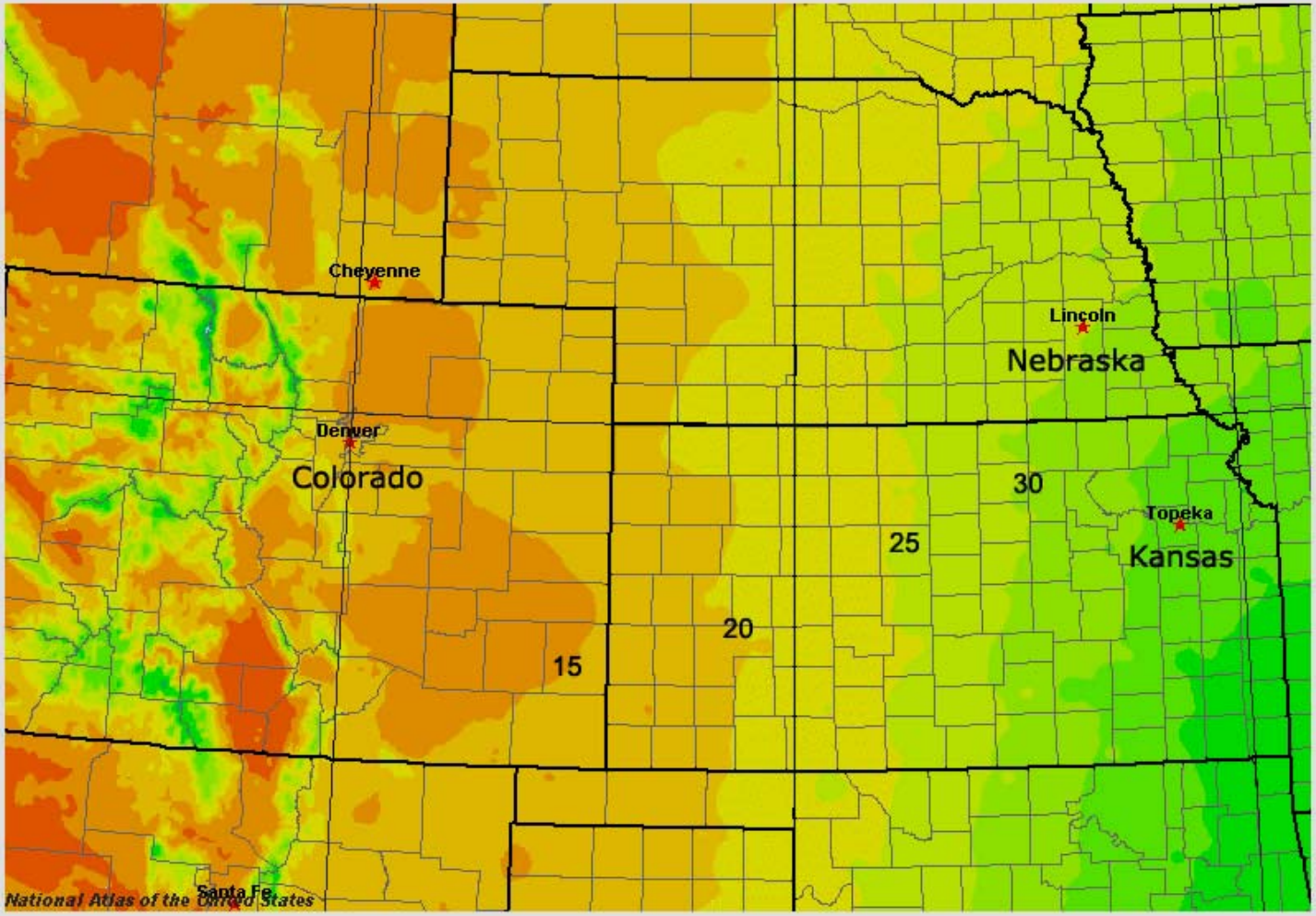


Reference Evapotranspiration (ET)



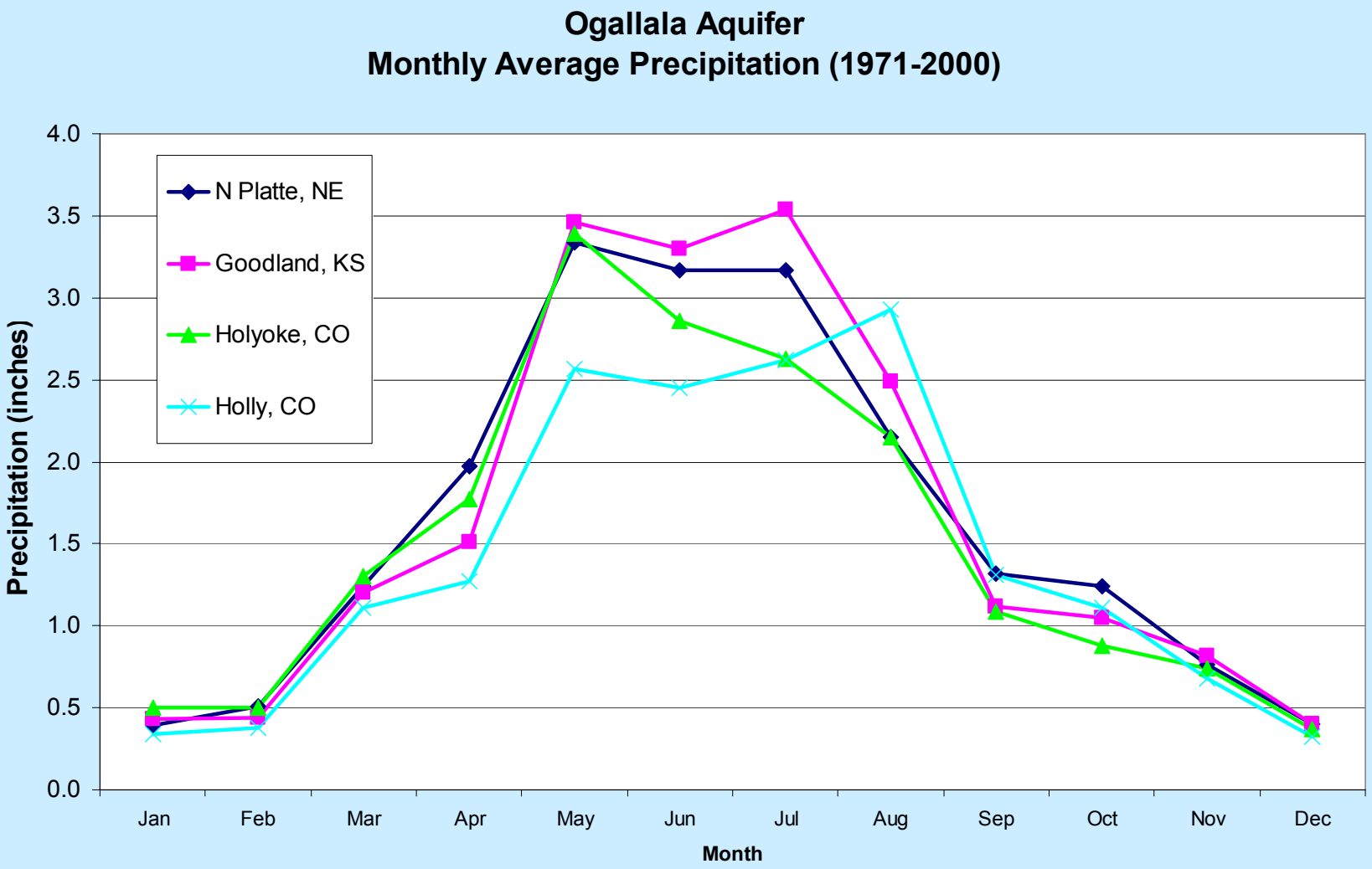
COLORADO, KANSAS AND NEBRASKA

AVERAGE ANNUAL PRECIPITATION, 1961-1990

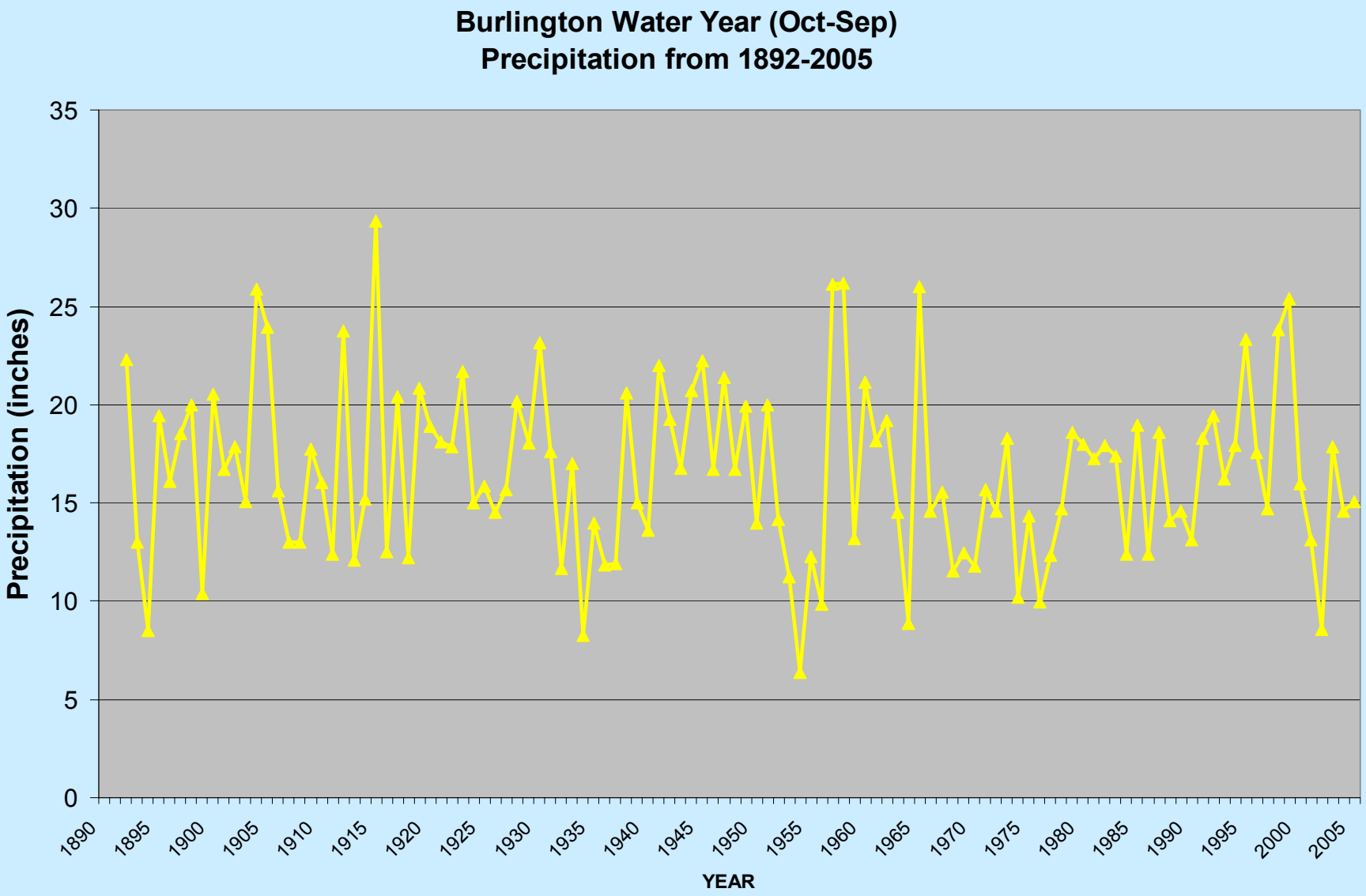


National Atlas of the United States, http://nationalatlas.gov

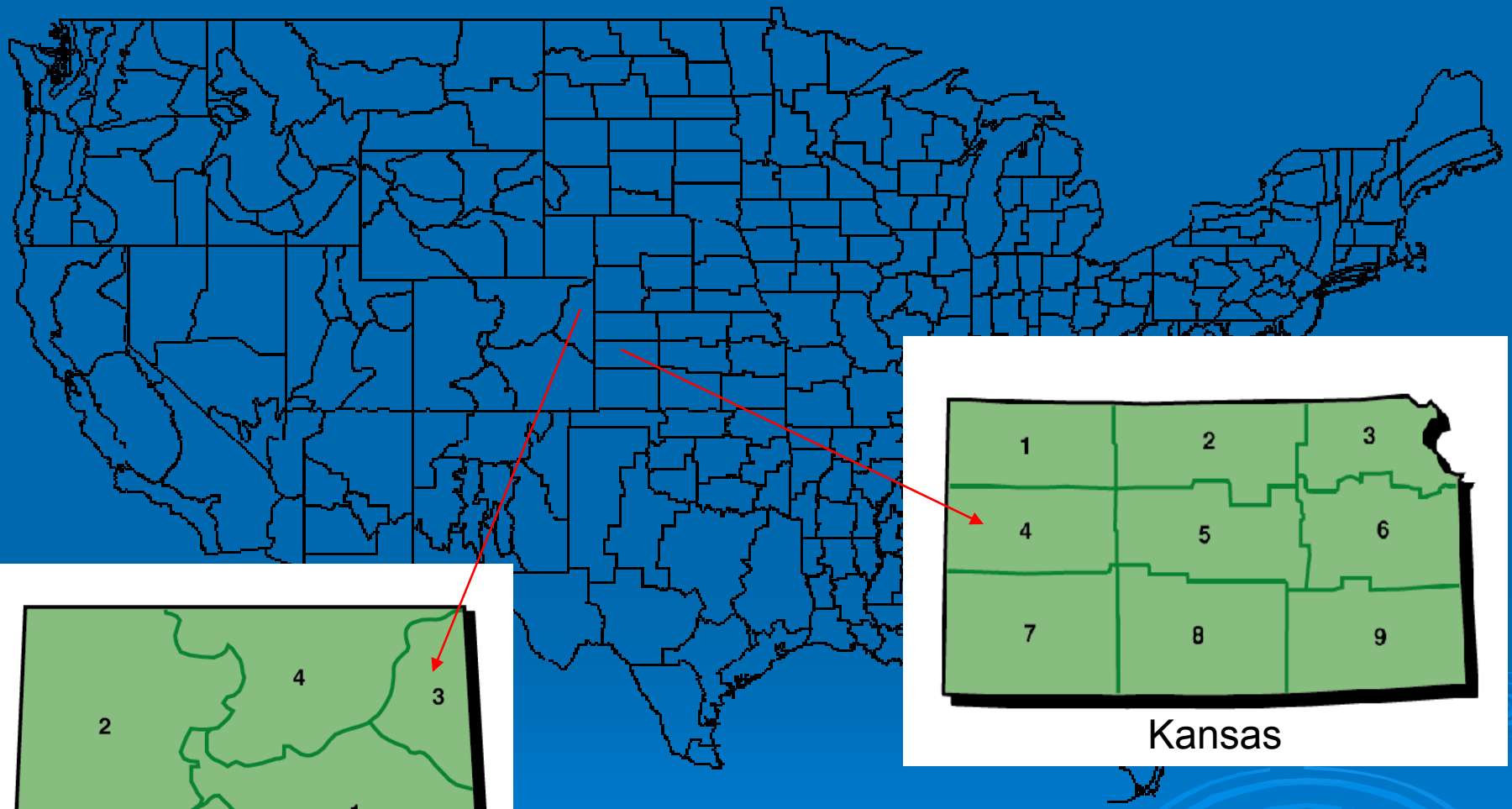
Monthly Average Precipitation for selected stations in the Ogallala Aquifer

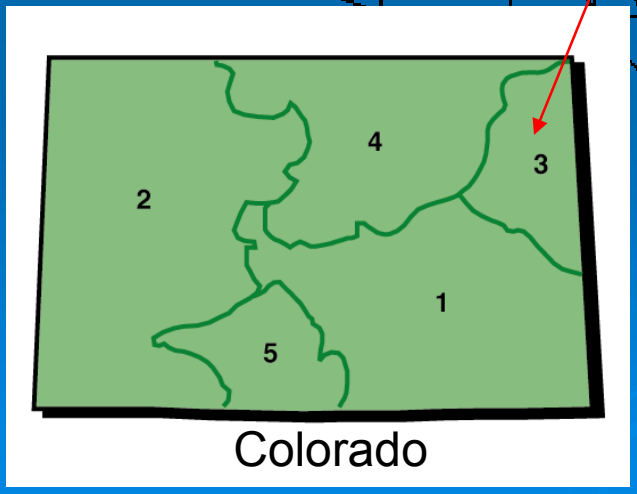


But are we ever "Average"?



Climate Divisions

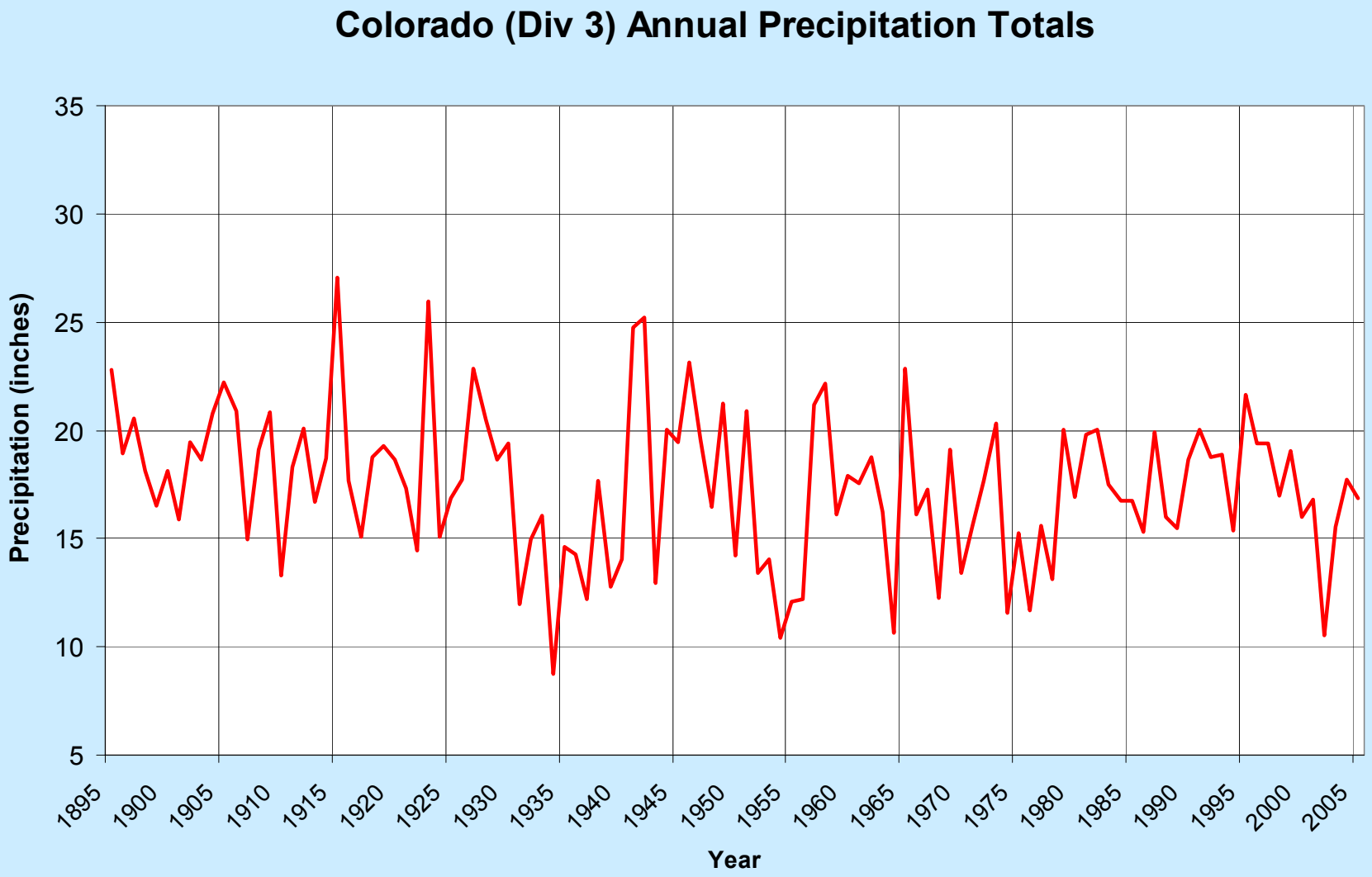




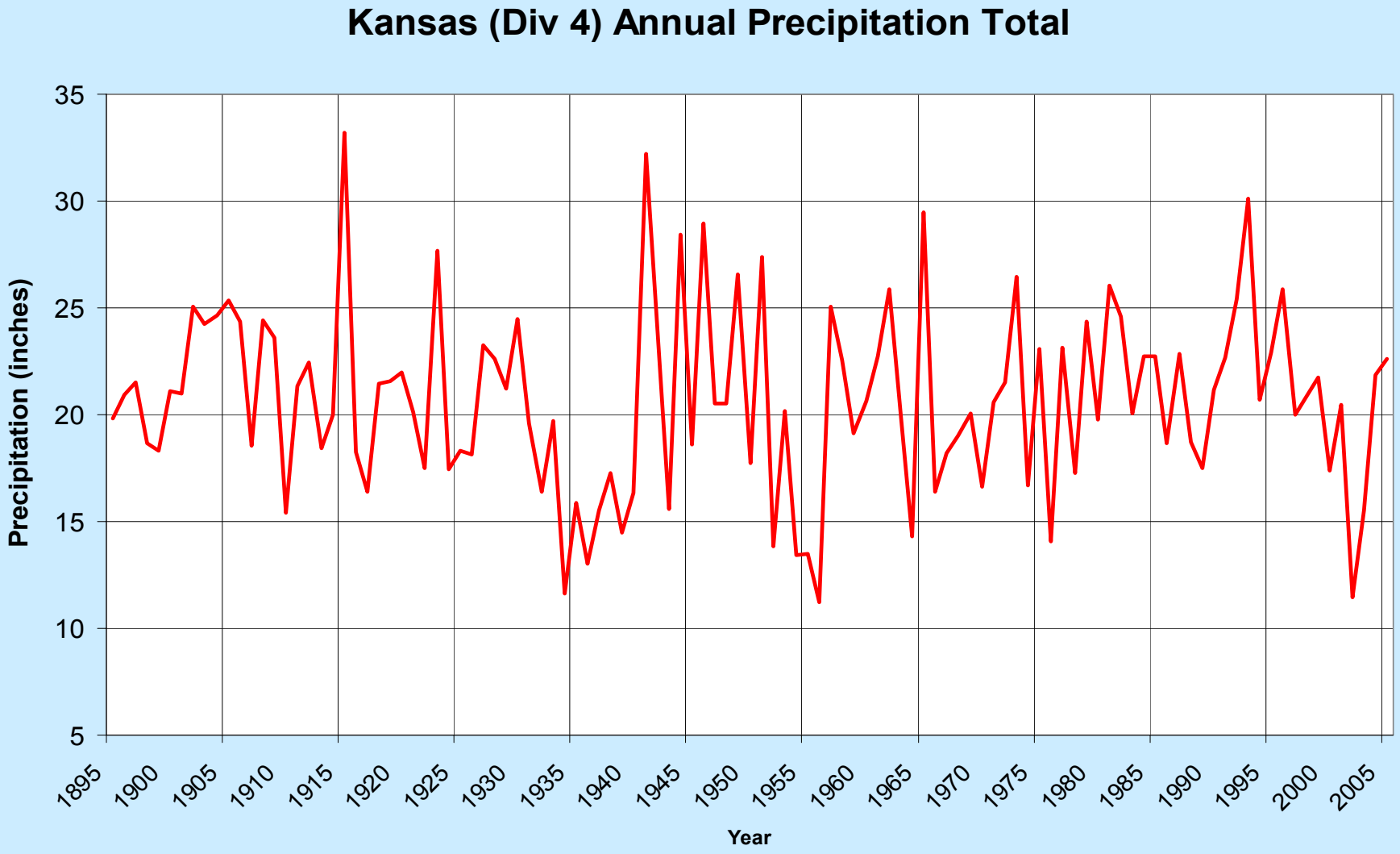
Colorado

Kansas

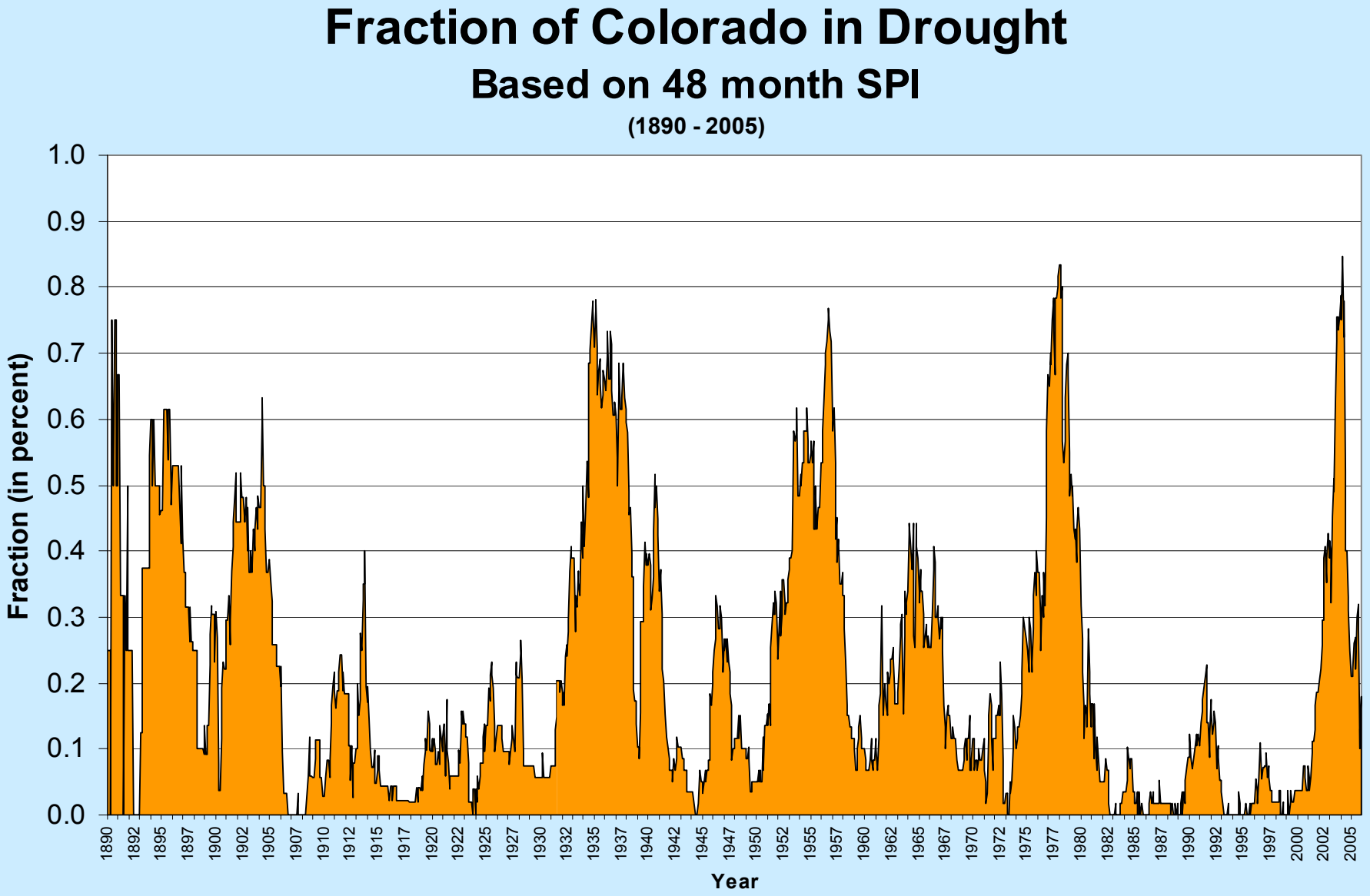
Kansas Basin (CO-03) Annual Precipitation Totals

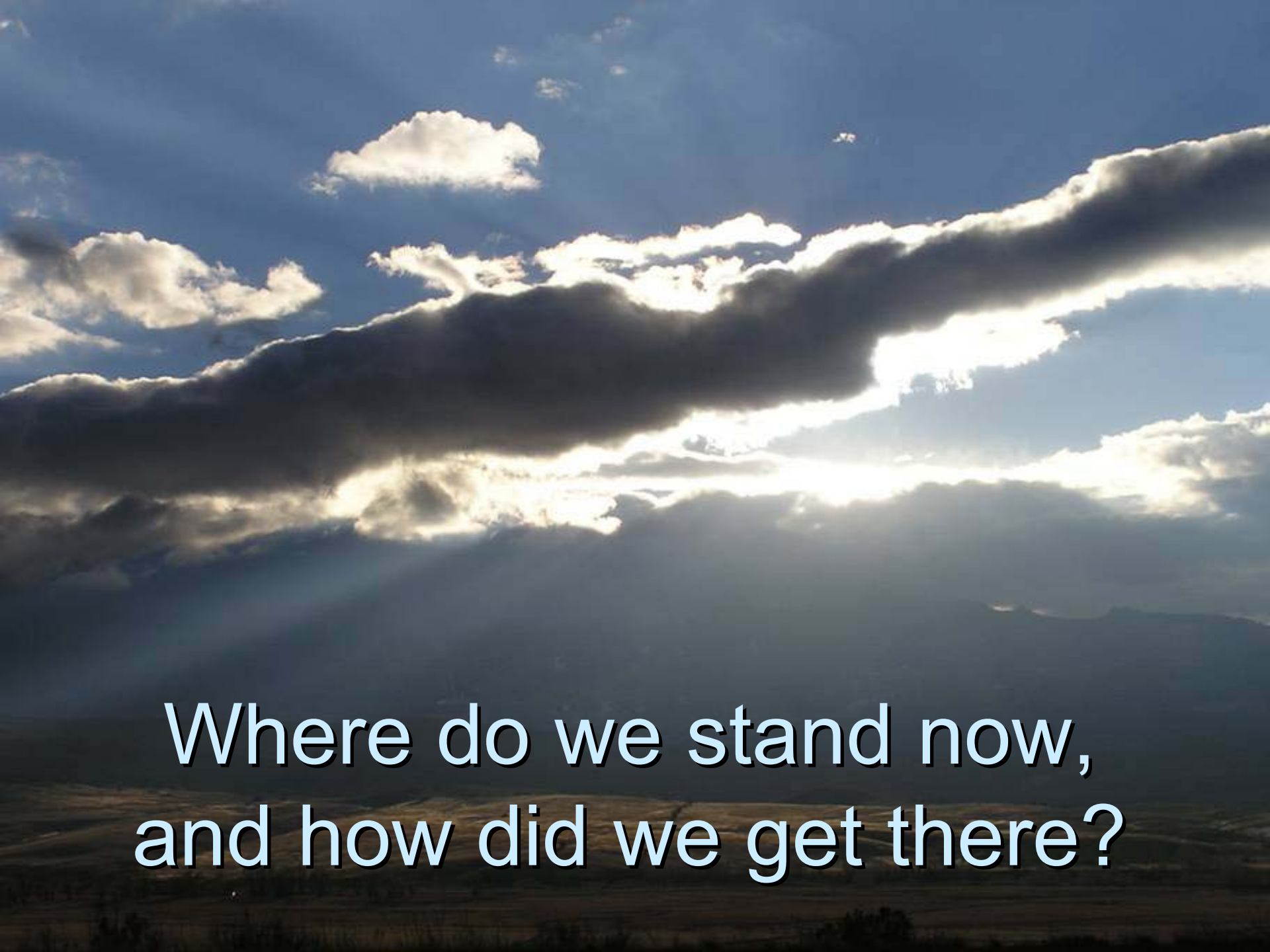


Kansas Northwest Basin (KS-04) Annual Precipitation Totals

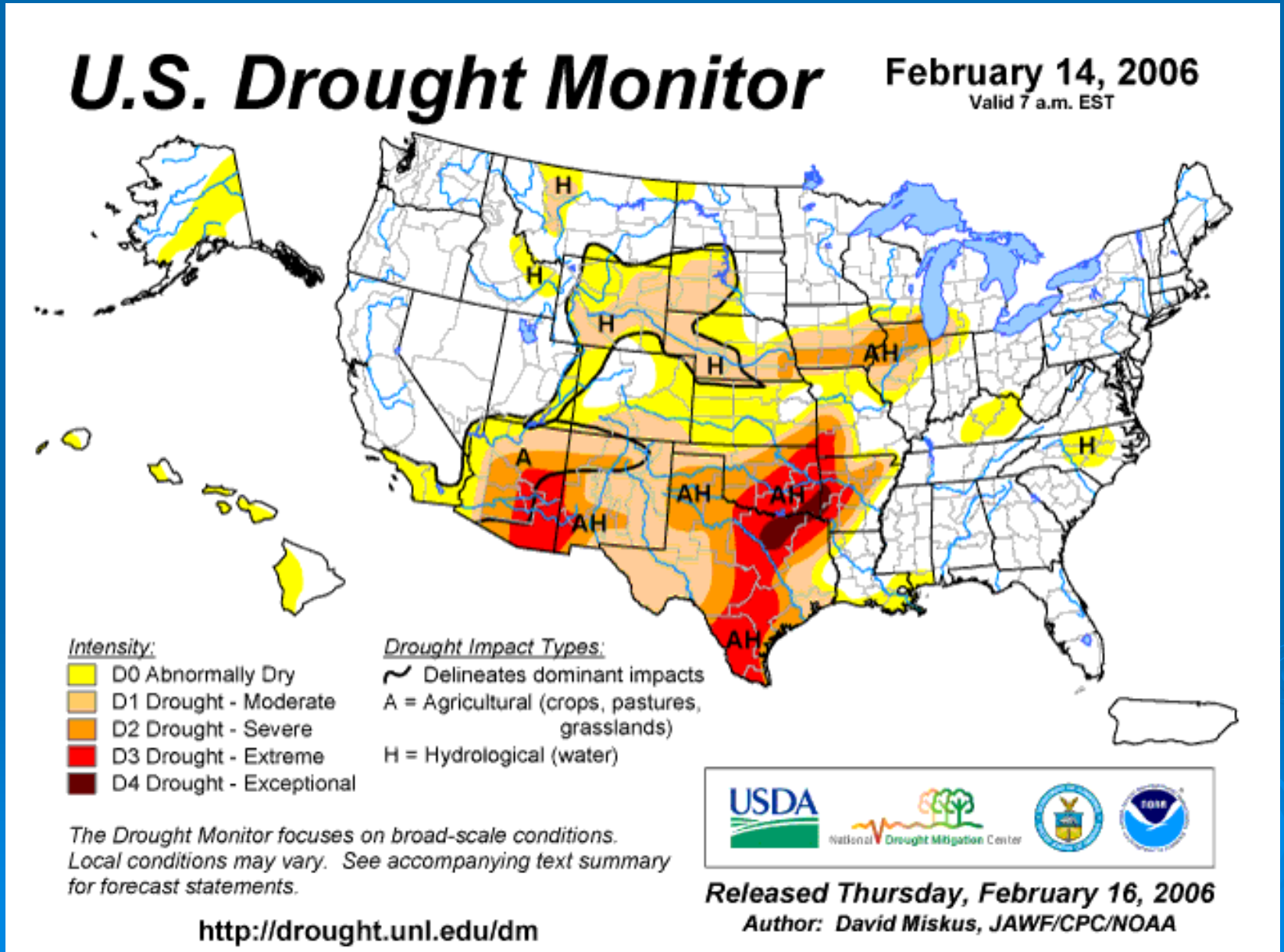


48-Month SPI

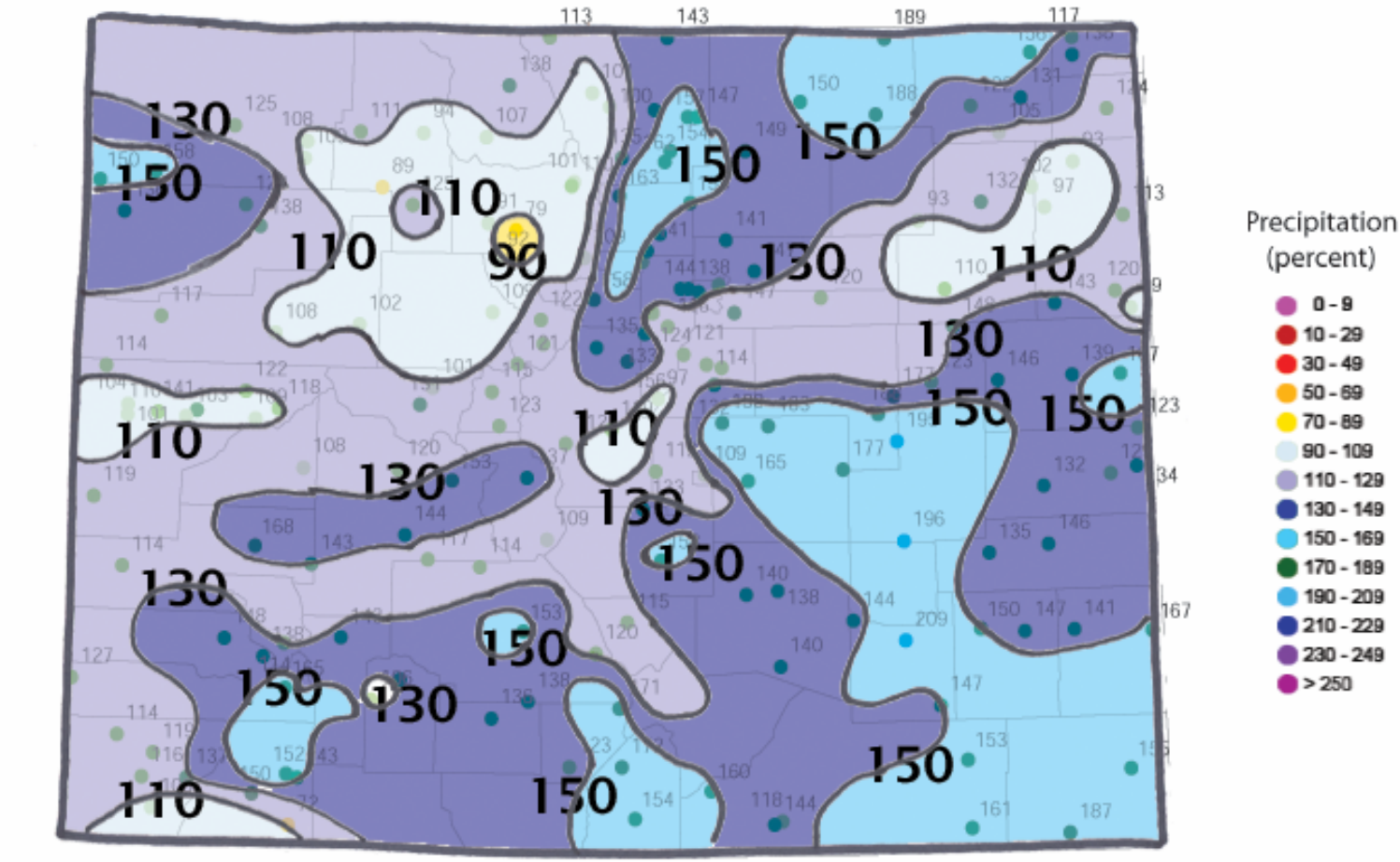

Fraction of Colorado in Drought
Based on 48 month SPI
(1890 - 2005)
Fraction (in percent)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
1890
1892
1895
1897
1900
1902
1905
1907
1910
1912
1915
1917
1920
1922
1925
1927
1930
1932
1935
1937
1940
1942
1945
1947
1950
1952
1955
1957
1960
1962
1965
1967
1970
1972
1975
1977
1980
1982
1985
1987
1990
1992
1995
1997
2000
2002
2005
Year


Where do we stand now,
and how did we get there?

Drought Monitor Map

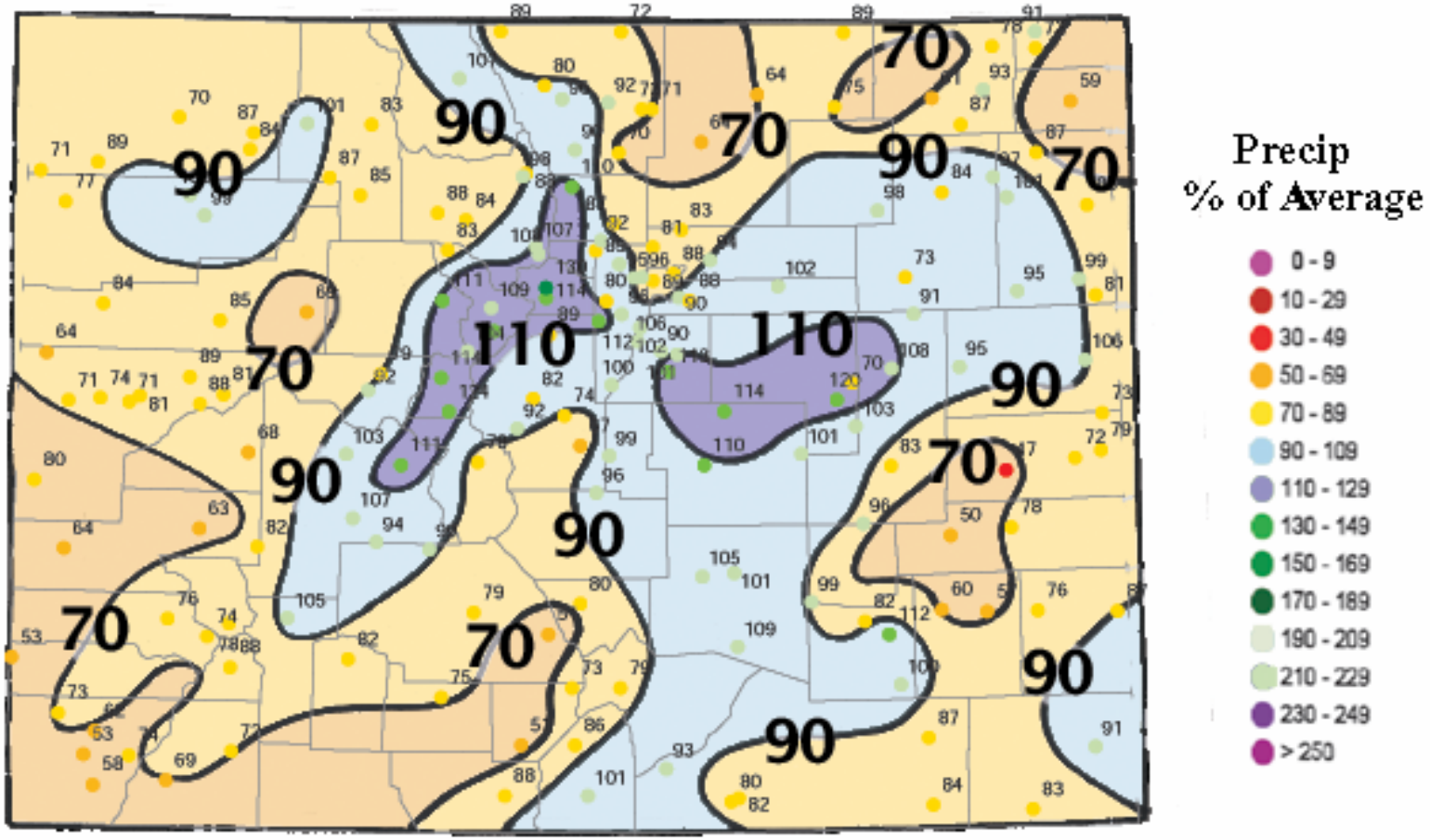


1999 Water Year Precipitation

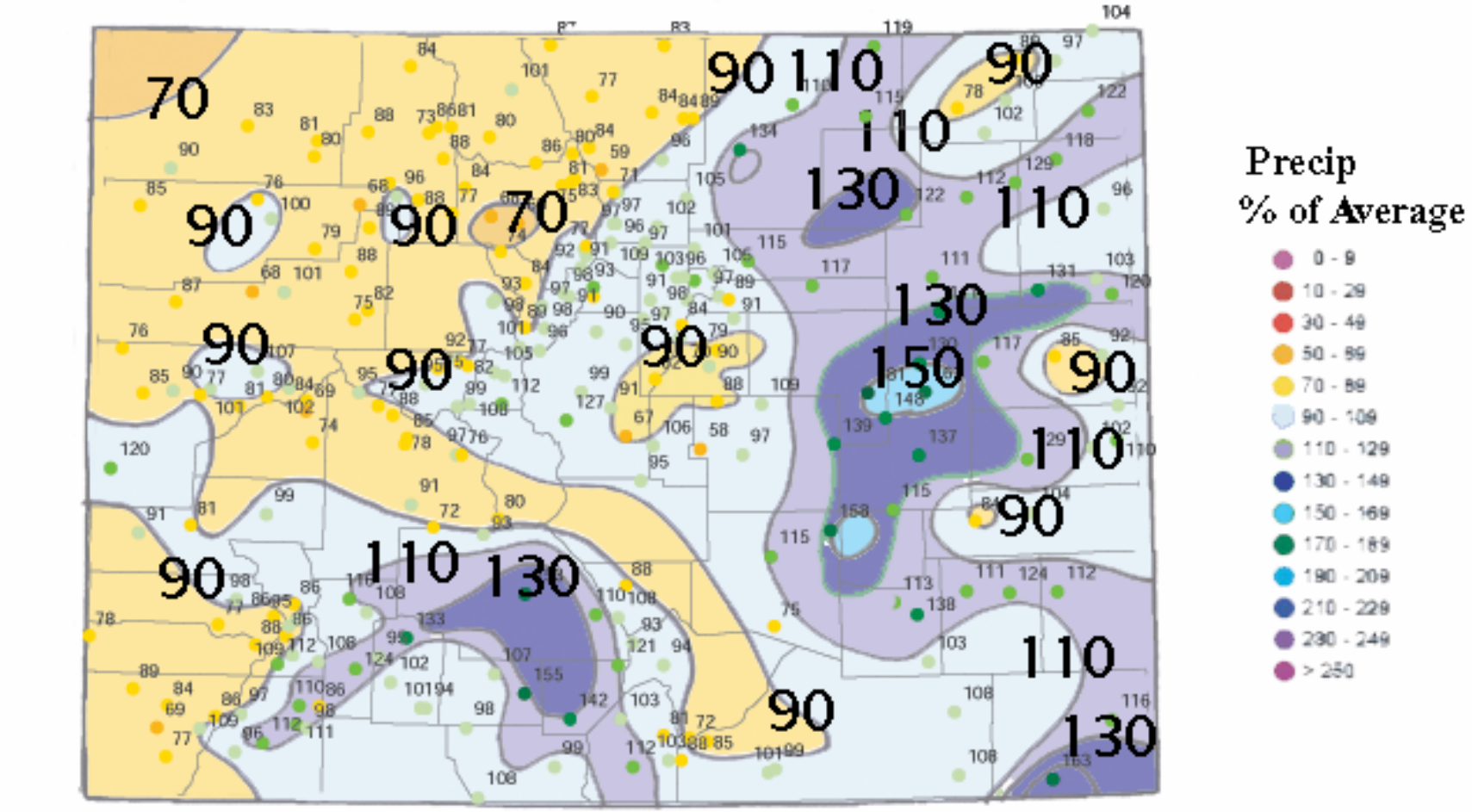


2000 Water Year Precipitation

Water Year 2000
(Oct. 1999 - Sept. 2000)
Precipitation Percent of Average for 1961-1990 Averages

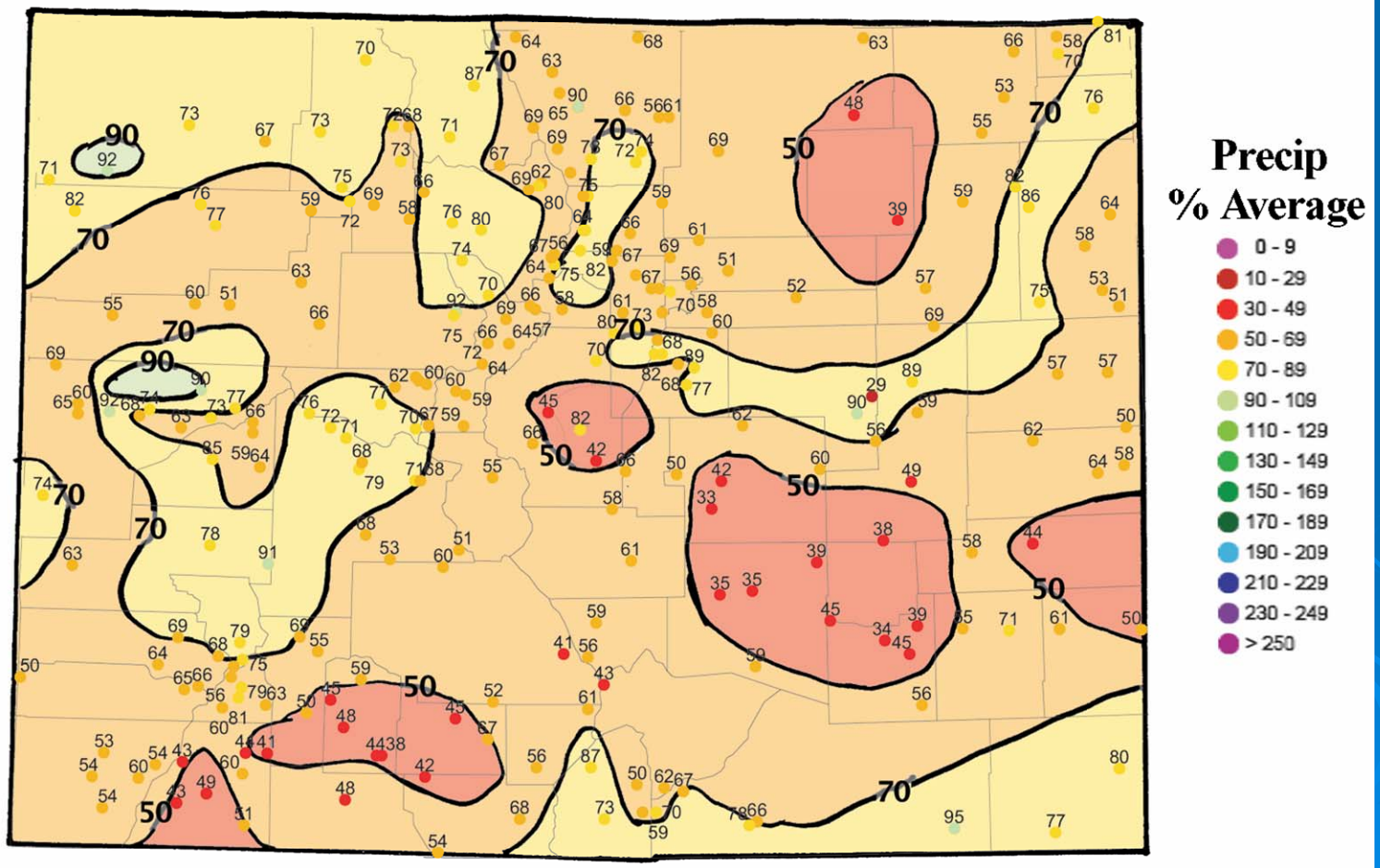


2001 Water Year Precipitation

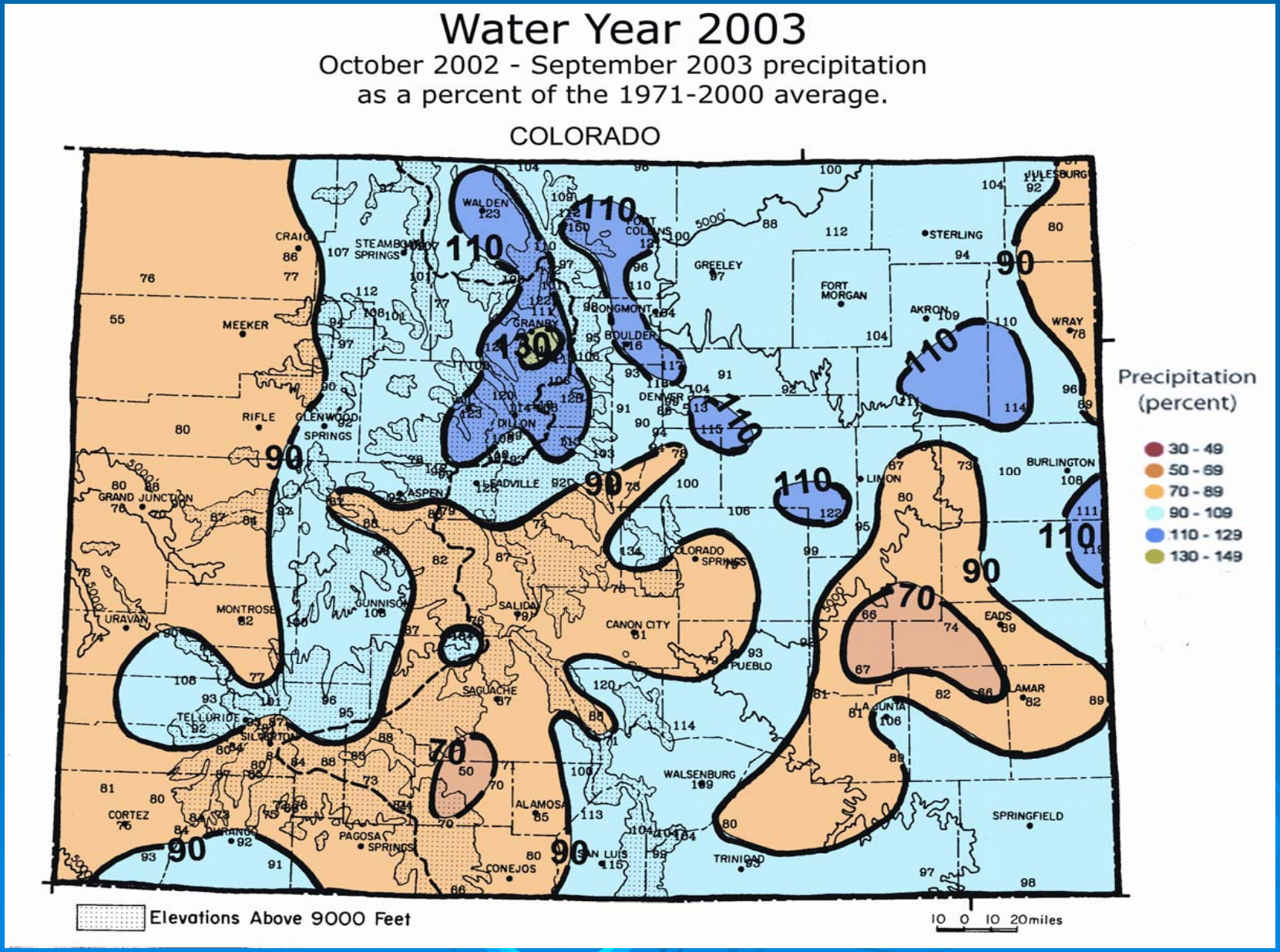


2002 Water Year Precipitation

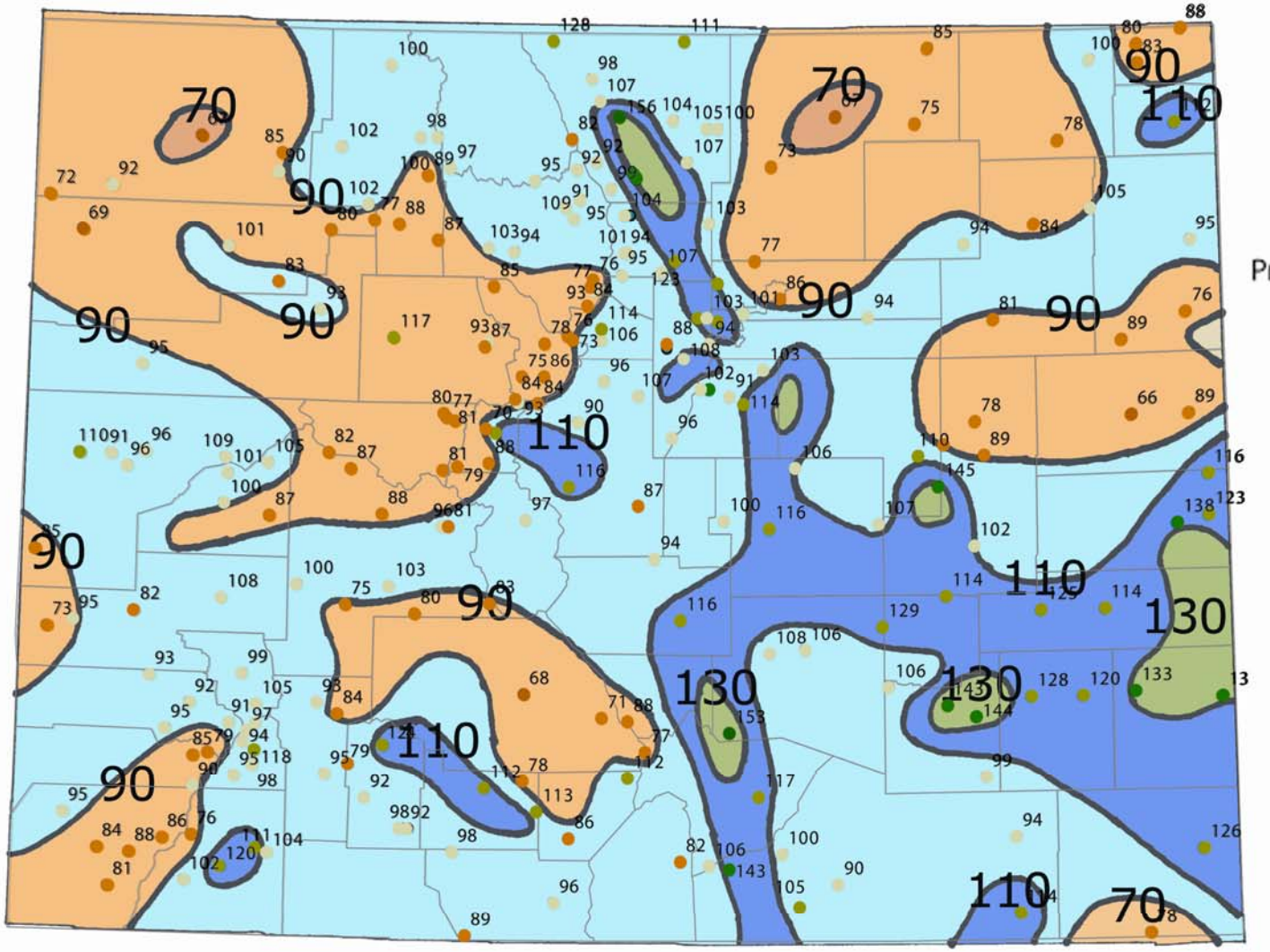
Water Year 2002
(Oct. 2001 - Sept. 2002)
Precipitation Percent of Average for 1961-1990 Averages



2003 Water Year Precipitation

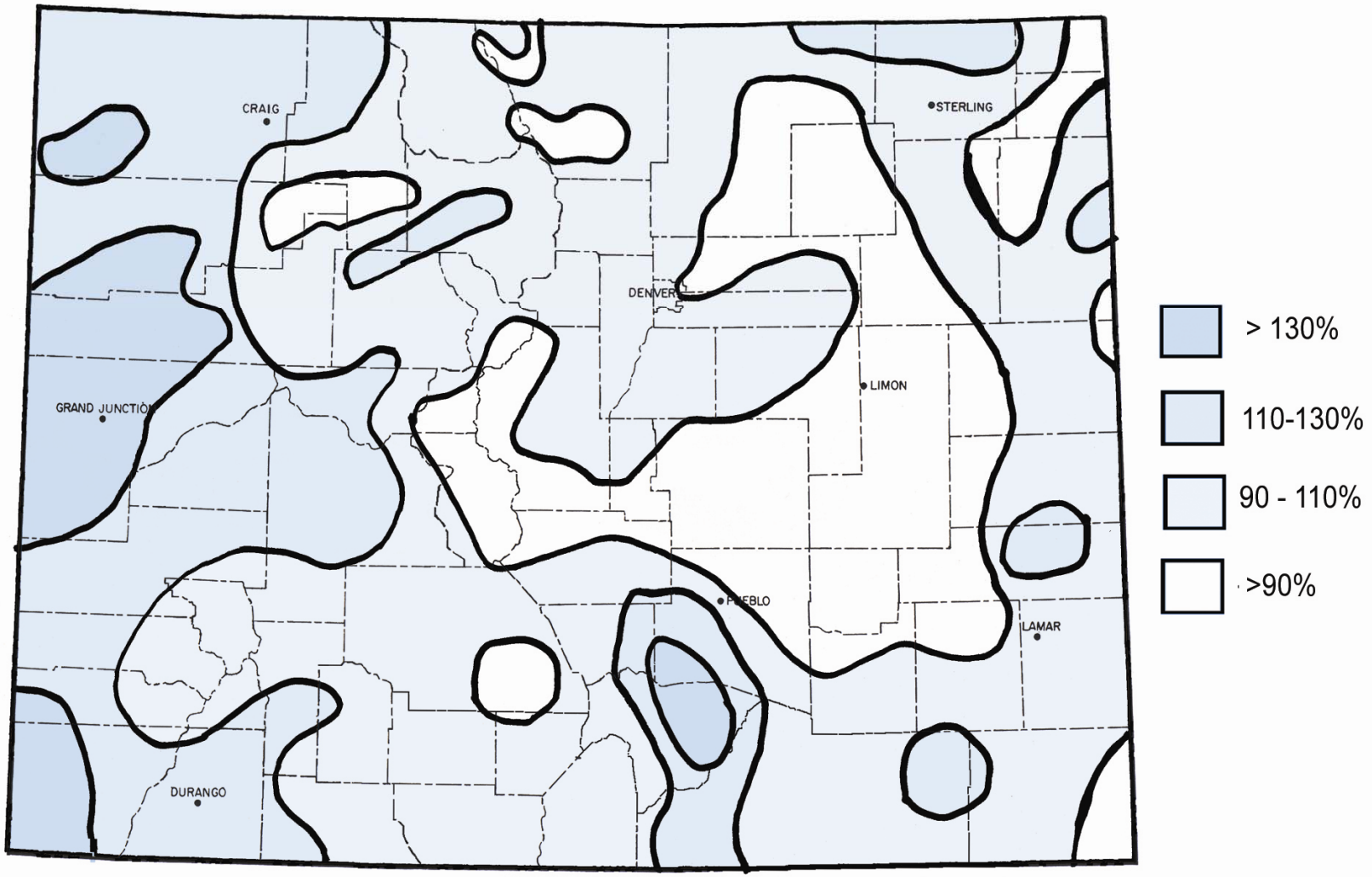


2004 Water Year Precipitation



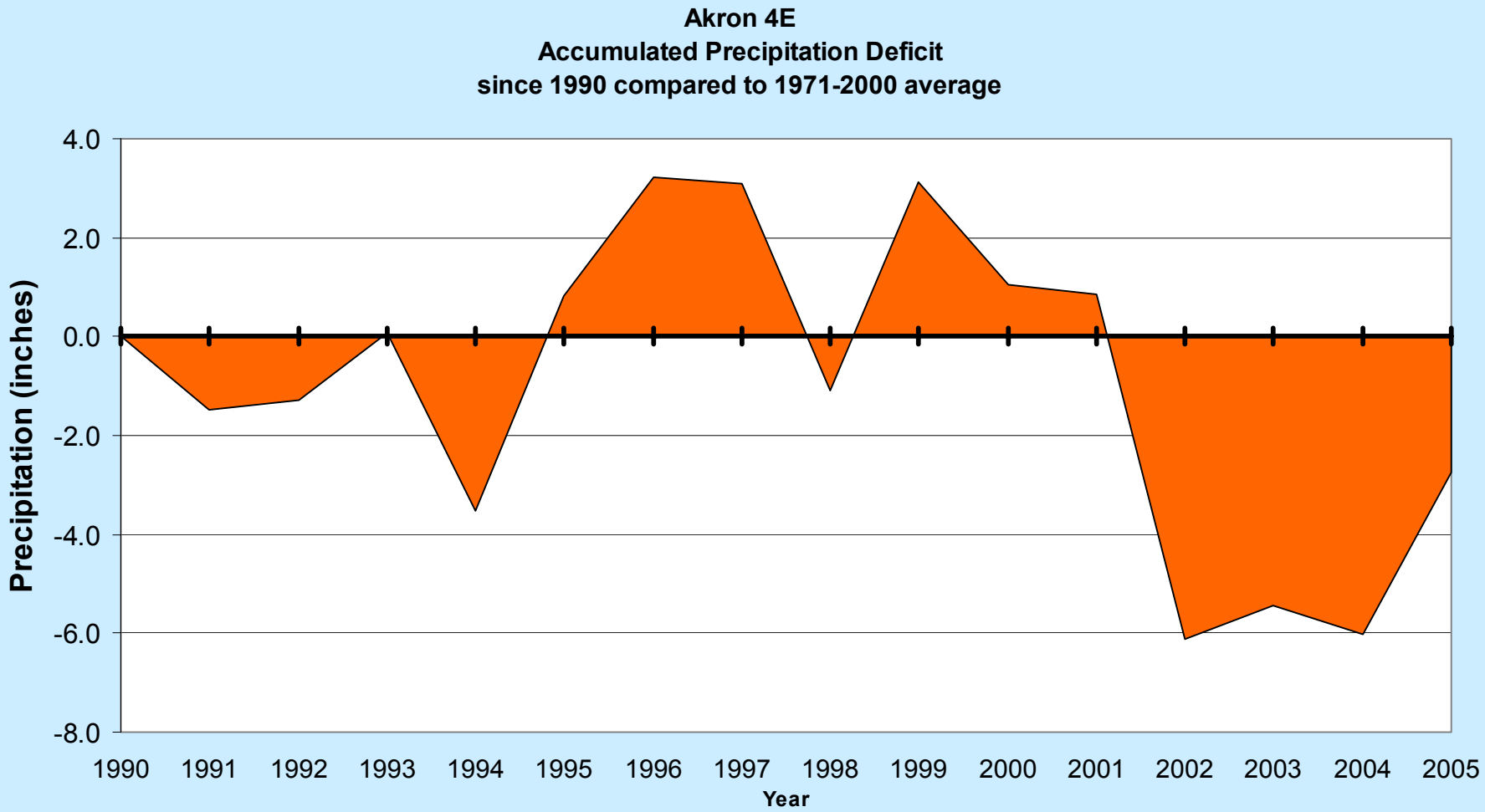
Water Year 2004 (October 2003 through September 2004) precipitation as a percent of the 1971-2000 average.

2005 Water Year Precipitation as Percent of Average

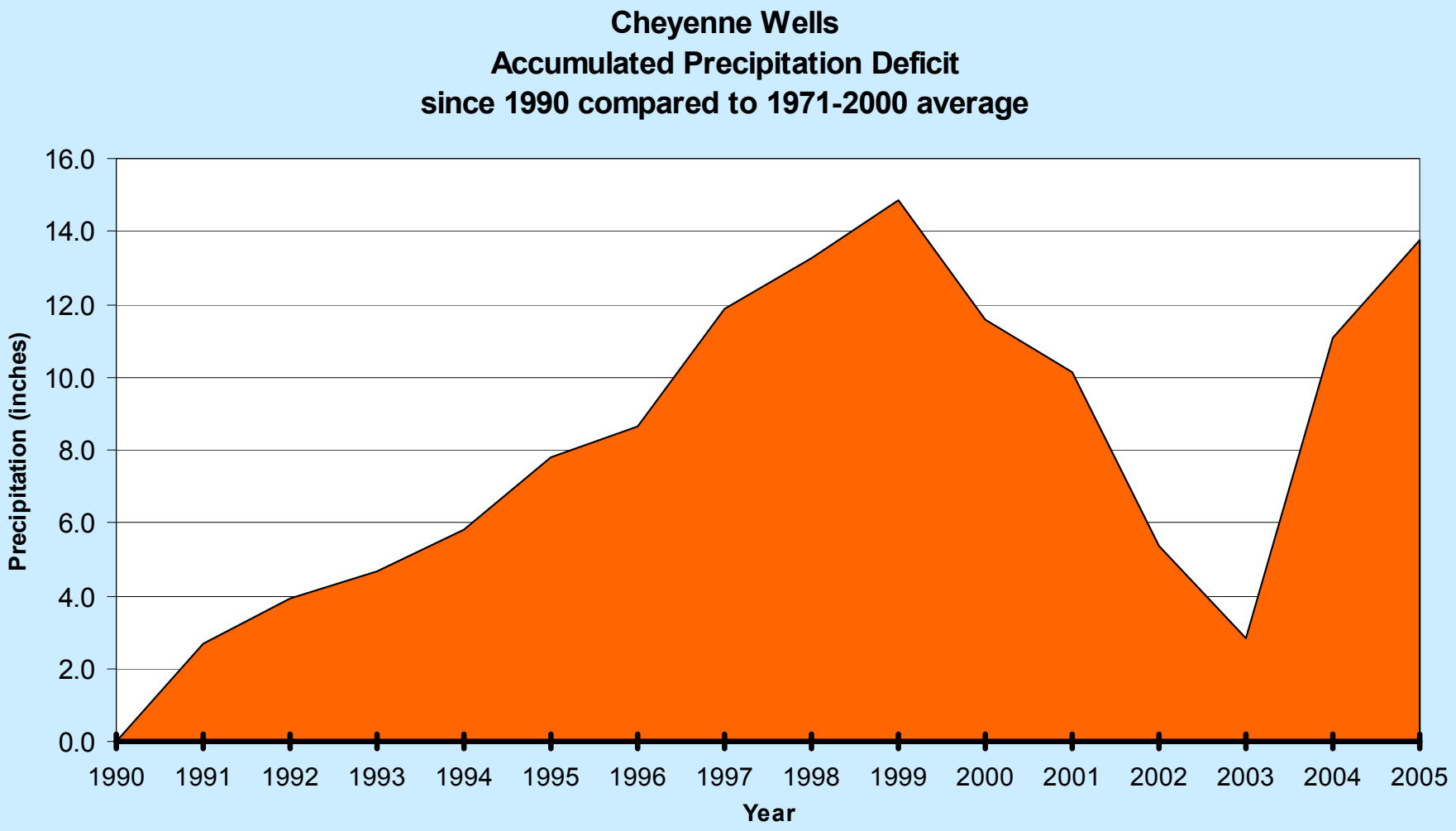


Water Year 2005 (Oct 04 - Sept. 05) precipitation as a percent of the 1971-2000 average.

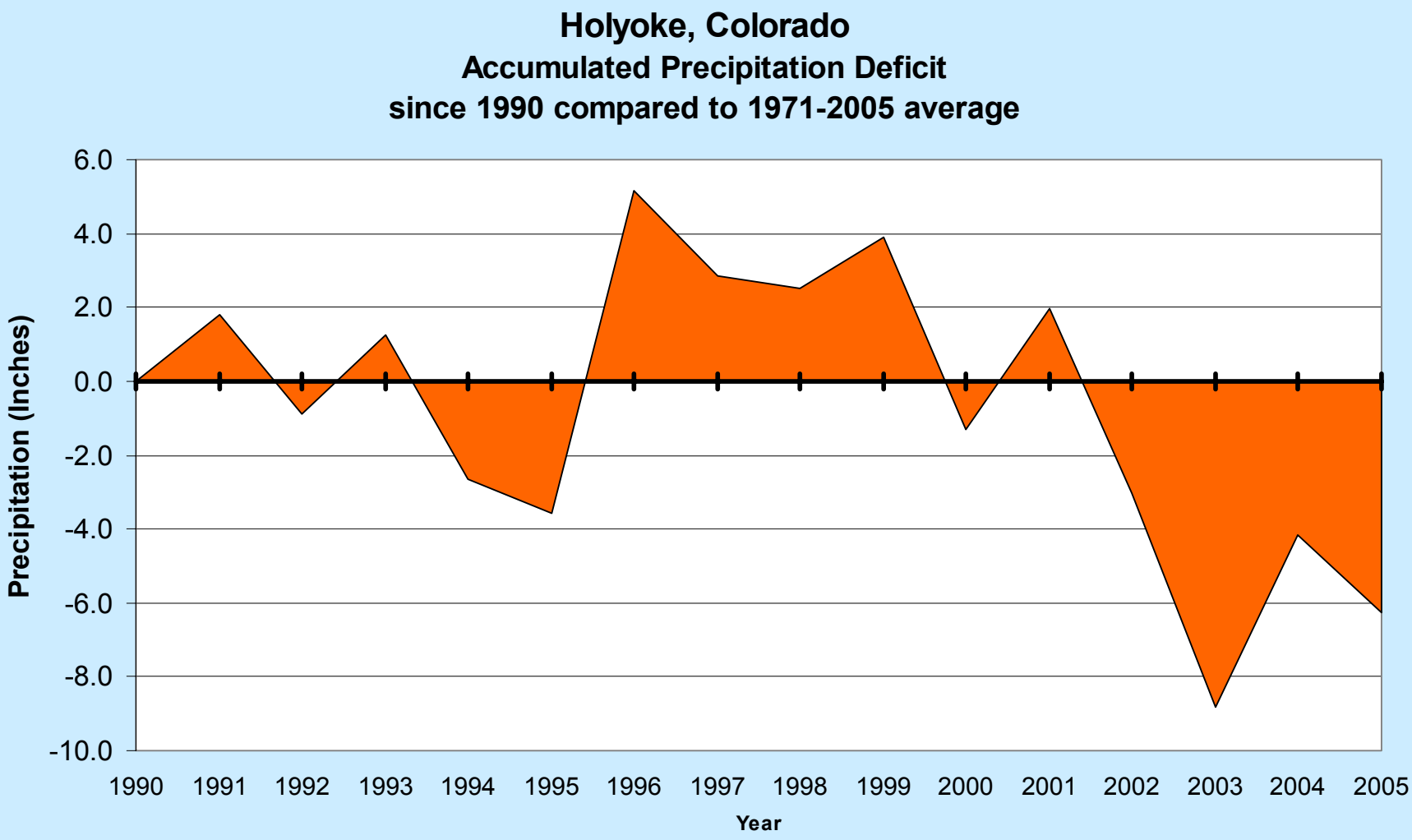
Akron Accumulated Precipitation Deficit



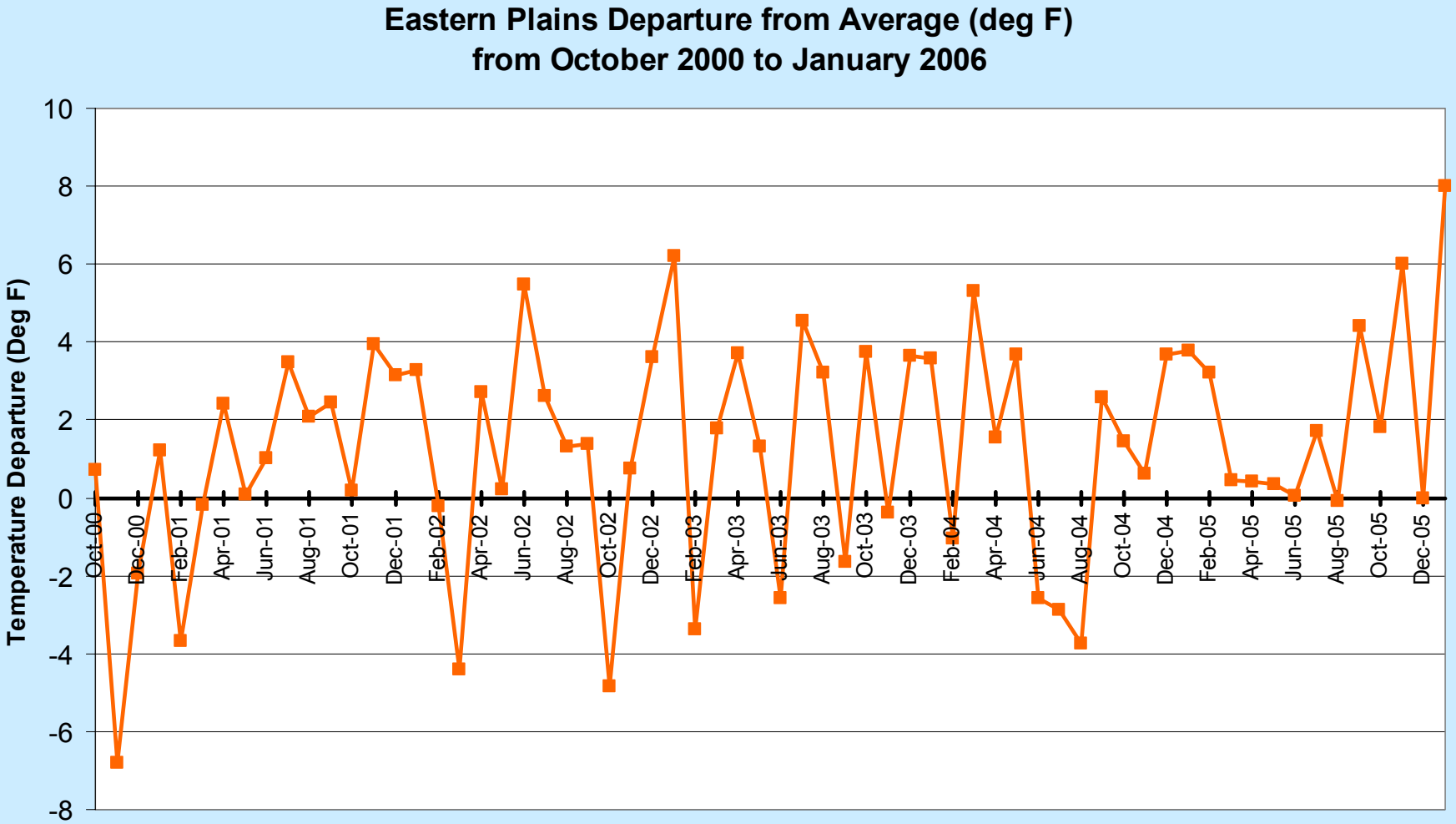
Cheyenne Wells Accumulated Precipitation



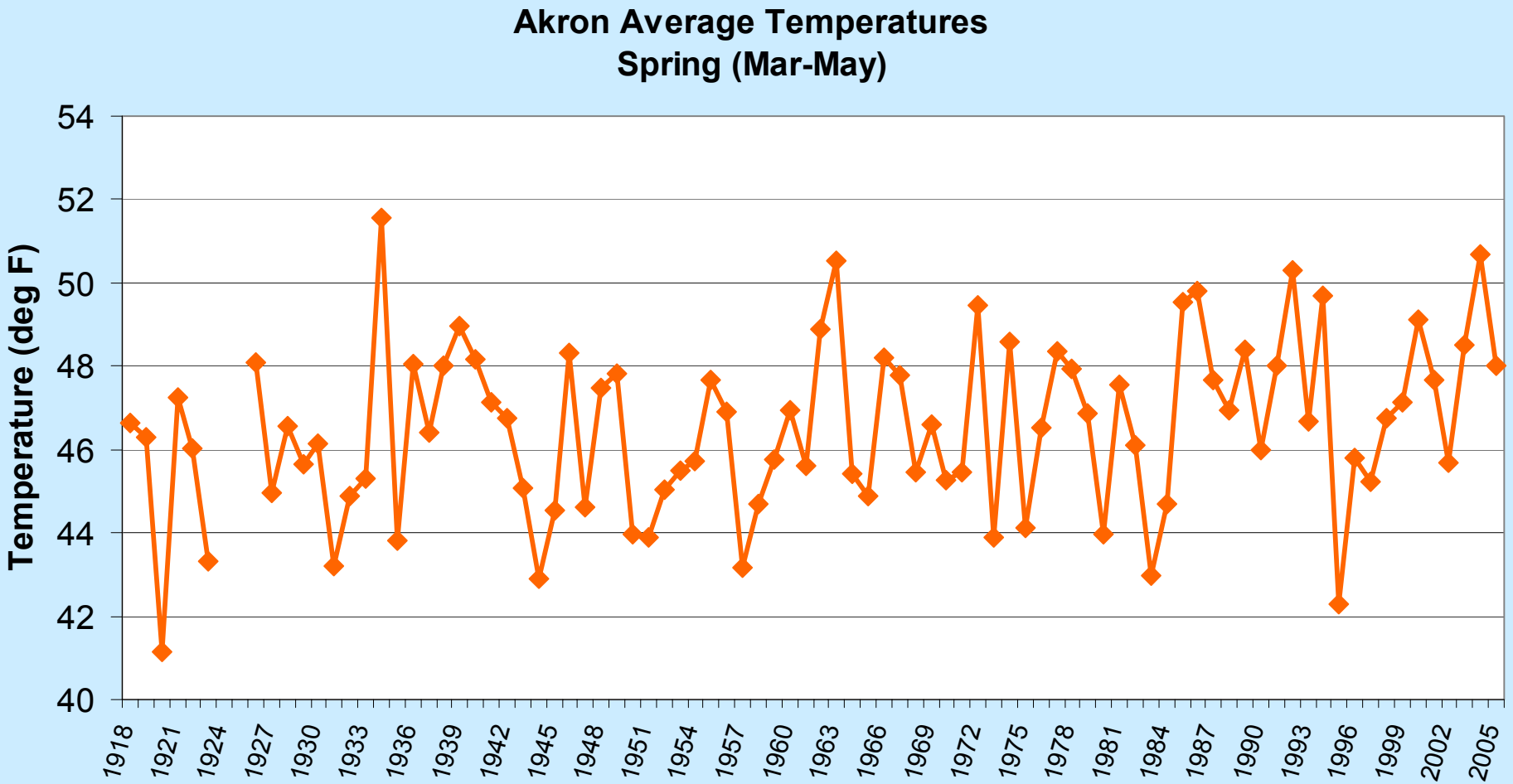
Holyoke Accumulated Precipitation



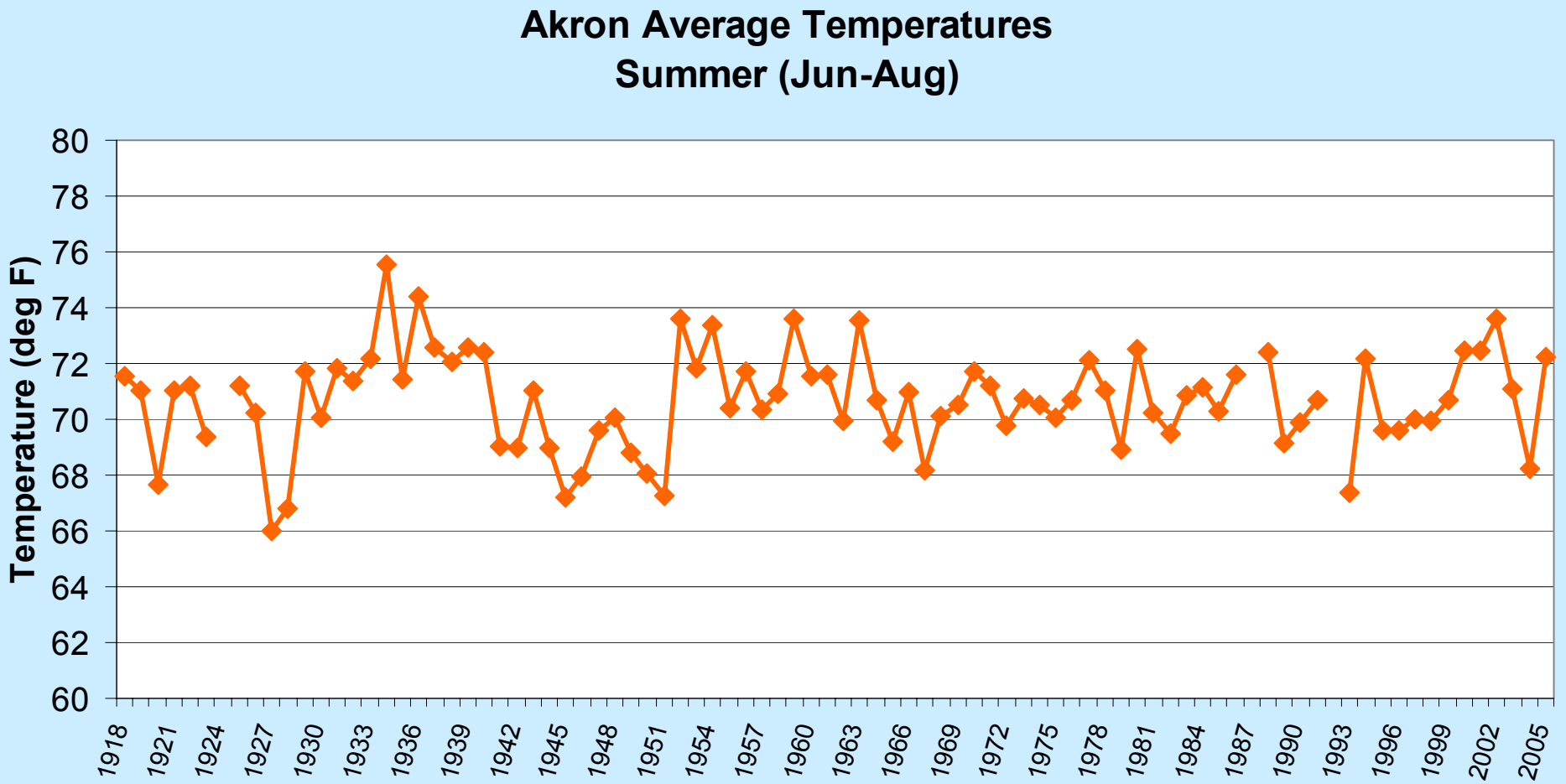
Eastern Plains Temperature Departures from Average



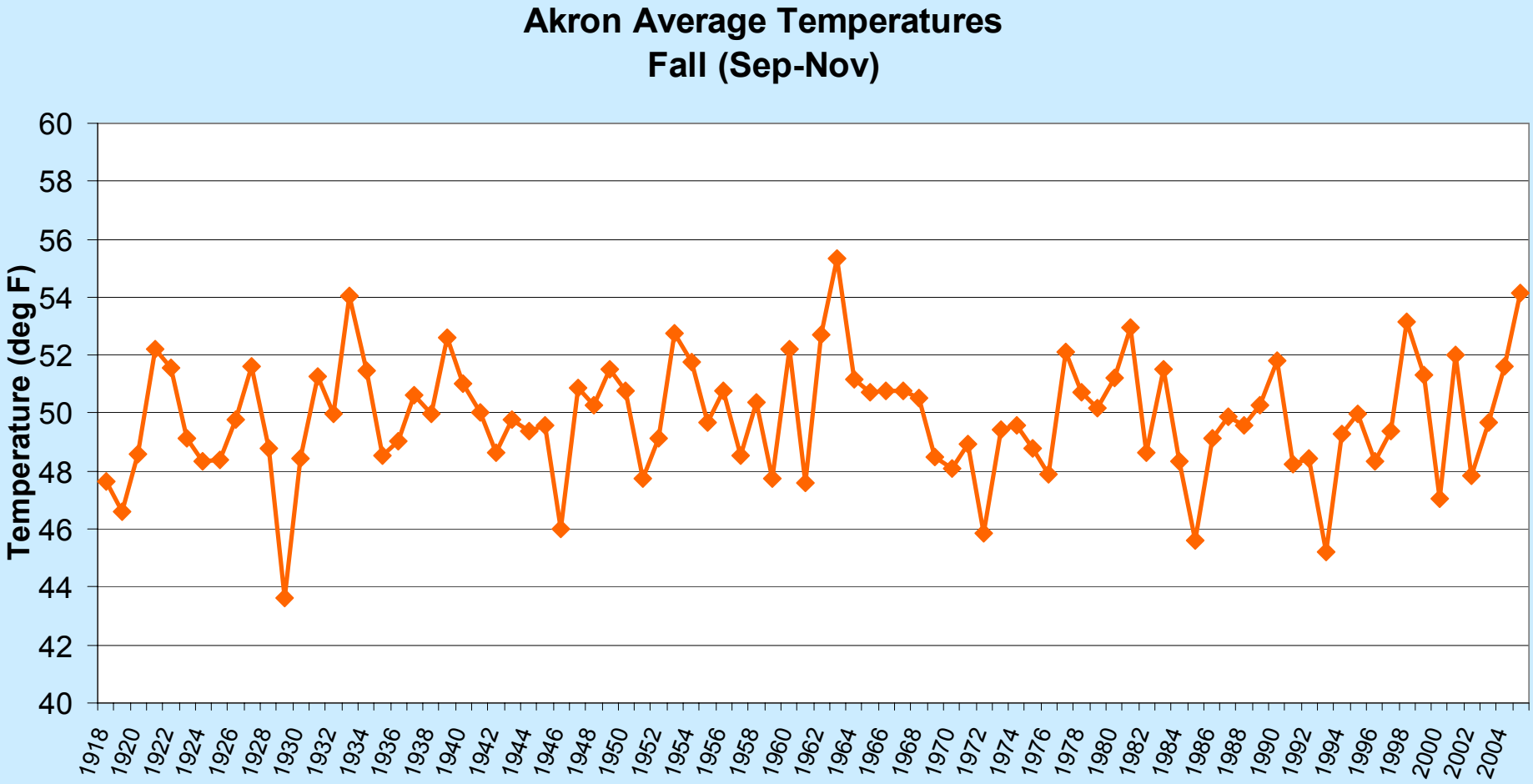
Akron Spring Temperatures



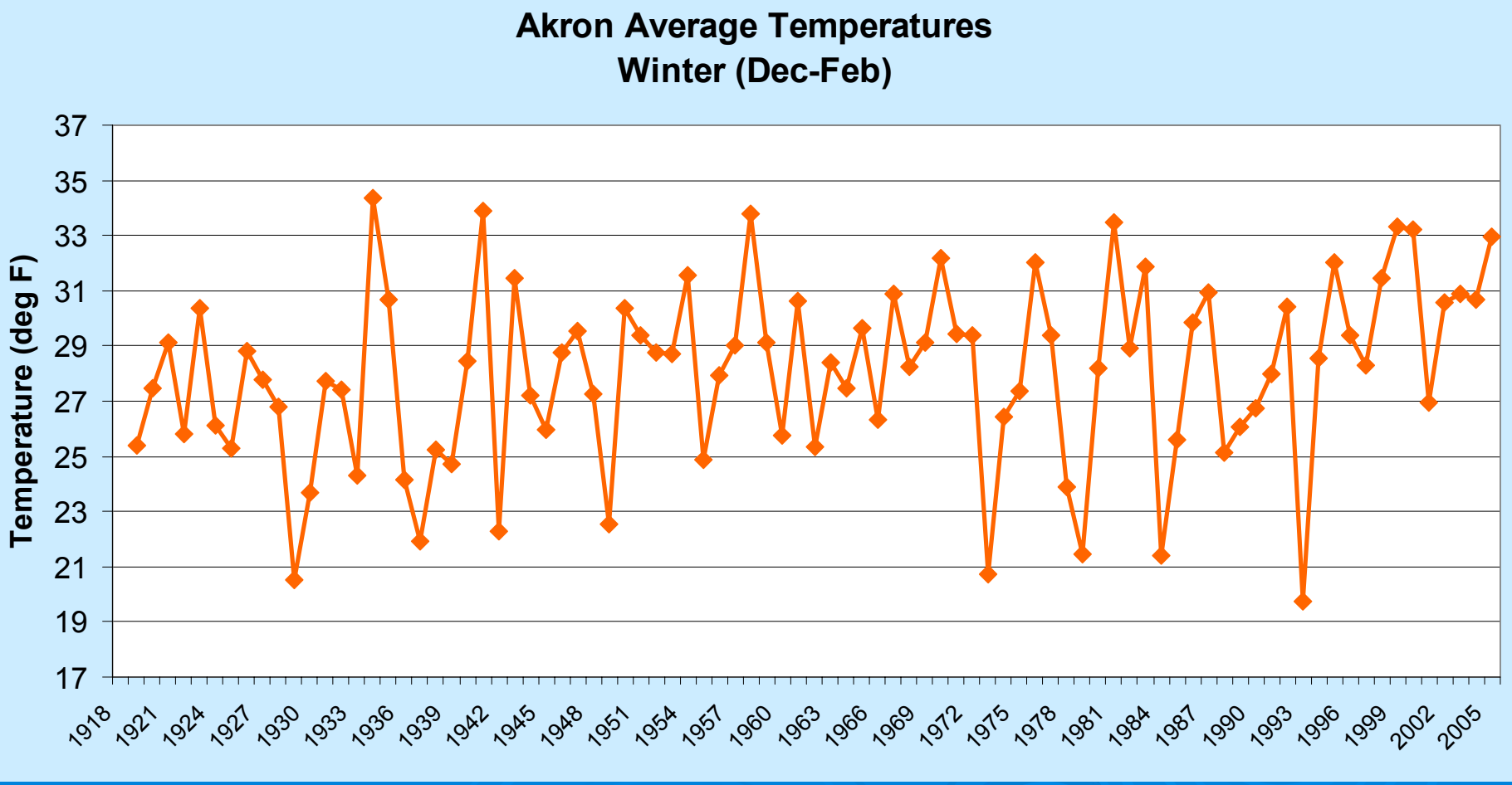
Akron Summer Temperatures



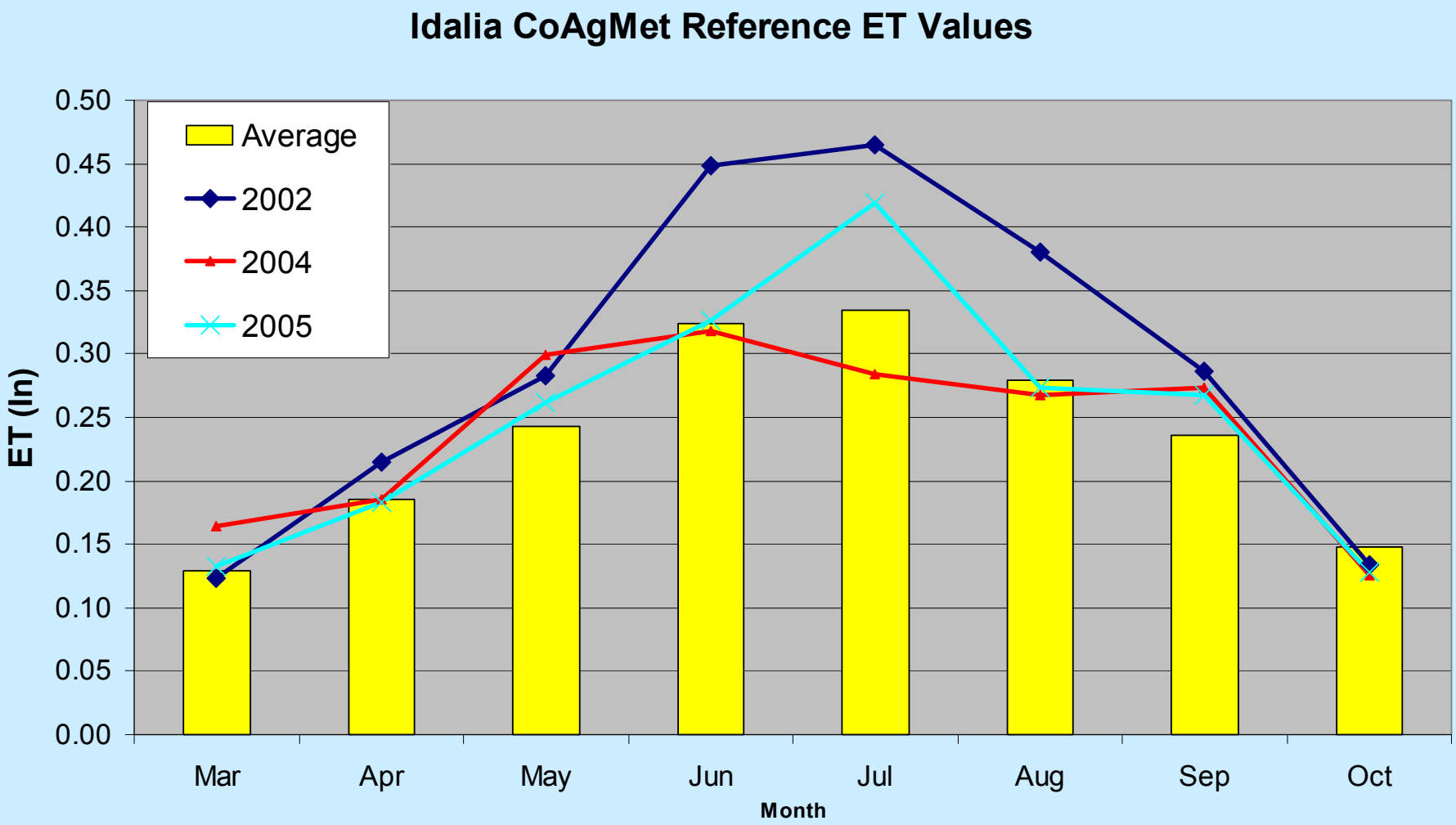
Akron Fall Temperatures



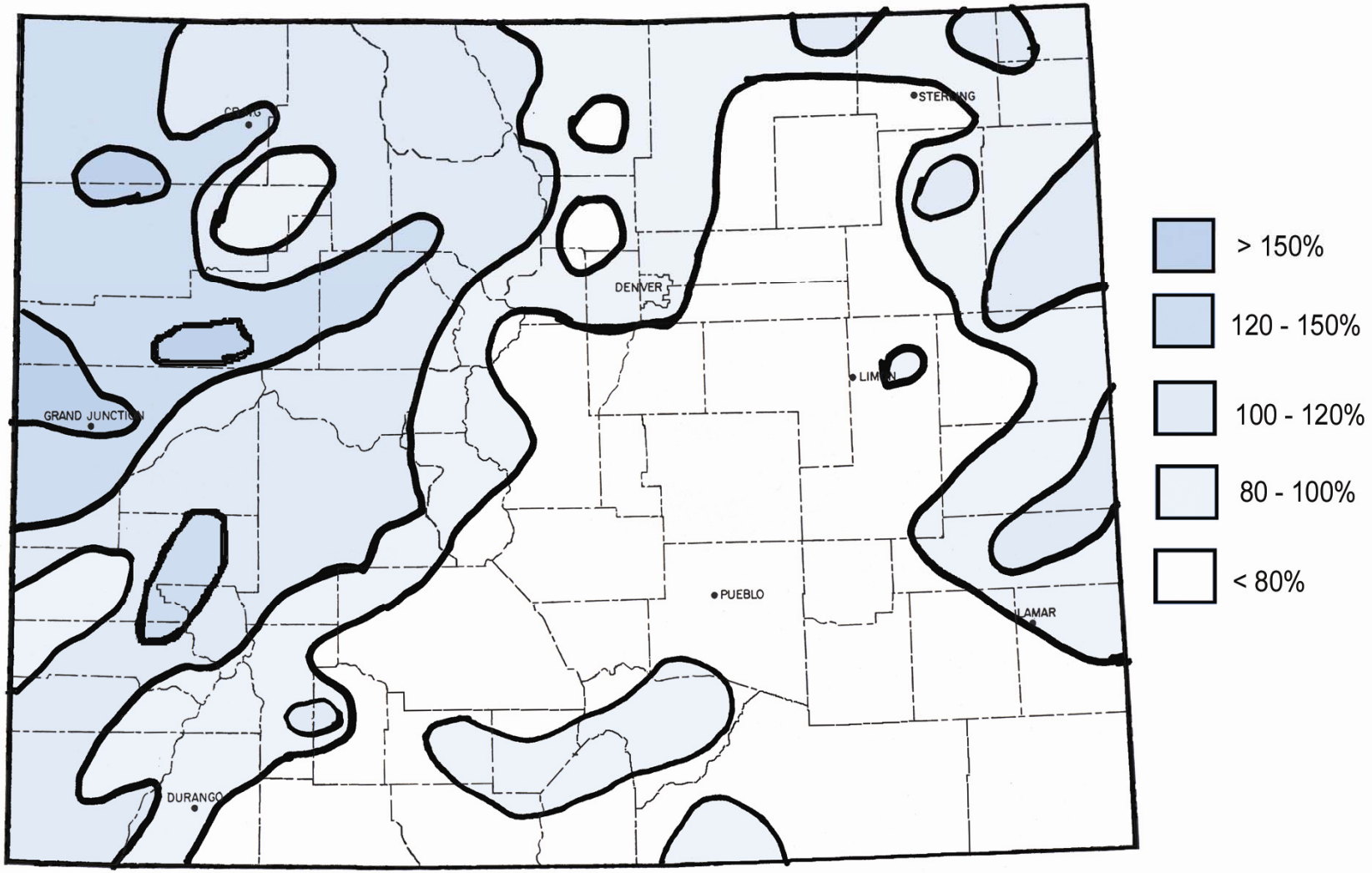
Akron Winter Temperatures



Idalia CoAgMet Reference ET

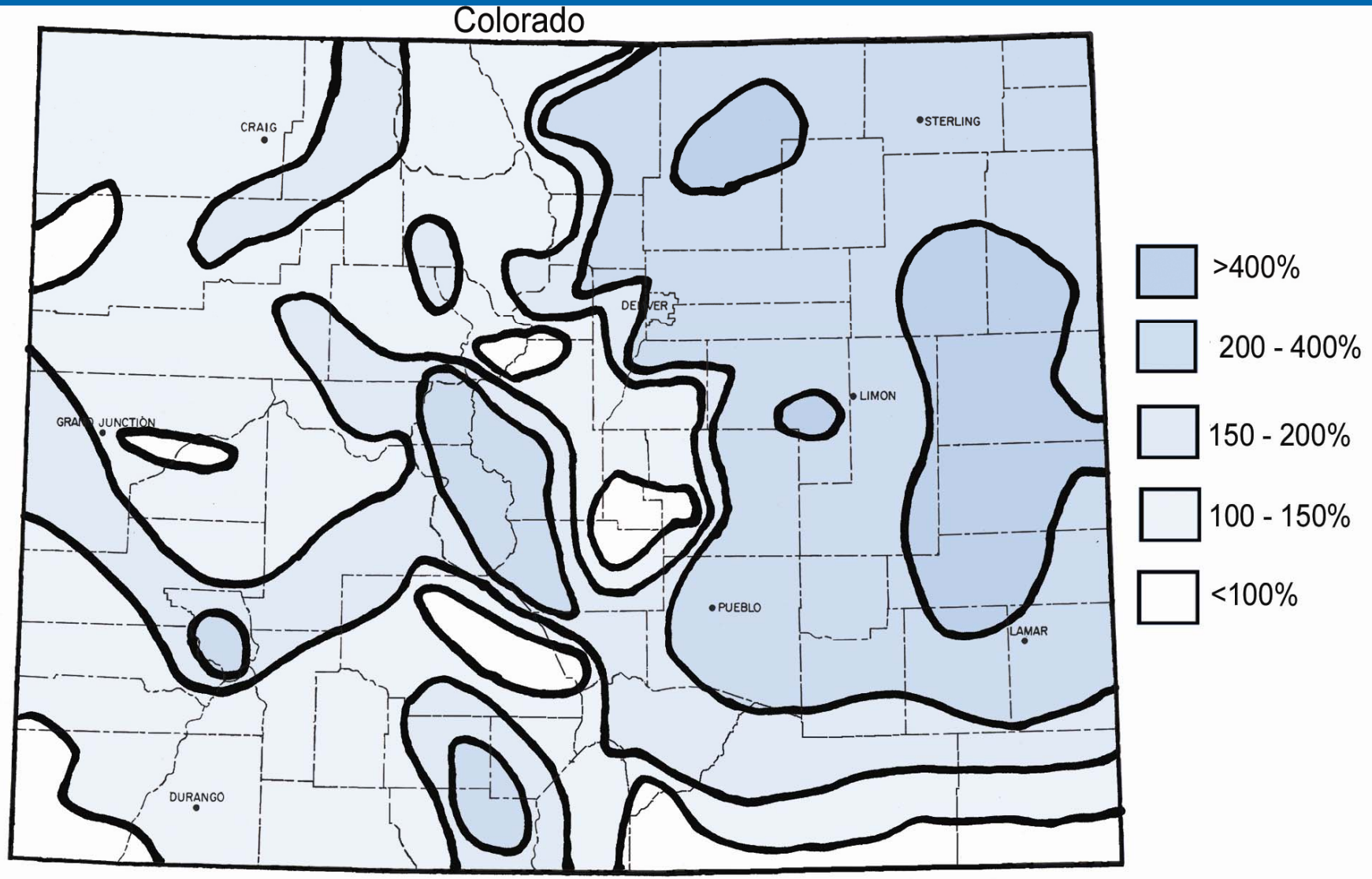


Summer (May – Sep) 2005 precipitation as percent of average



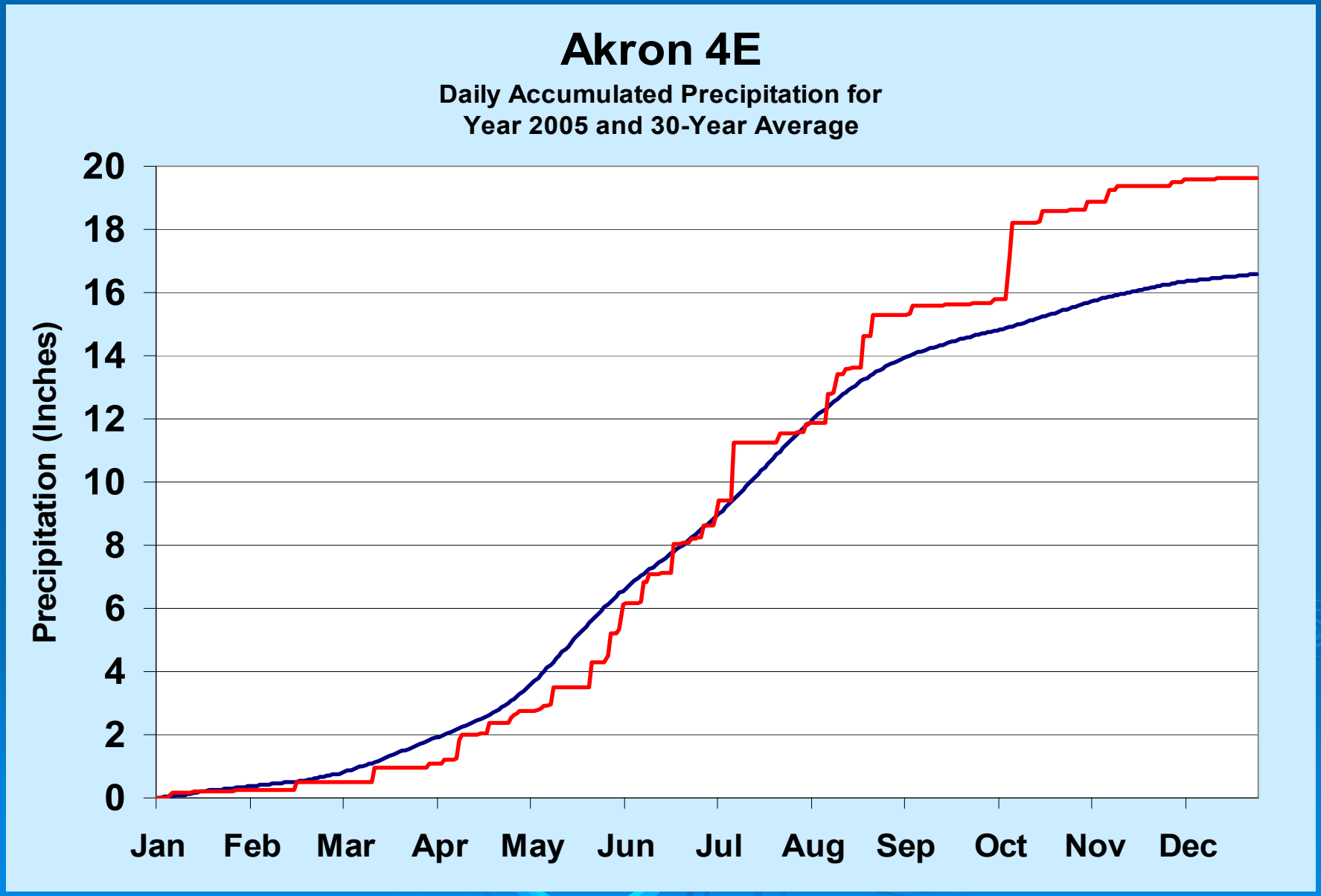
Summer (May - September) 2005 precipitation as a percent of the 1971-2000 average.

October 2005 Precipitation as Percent of Average

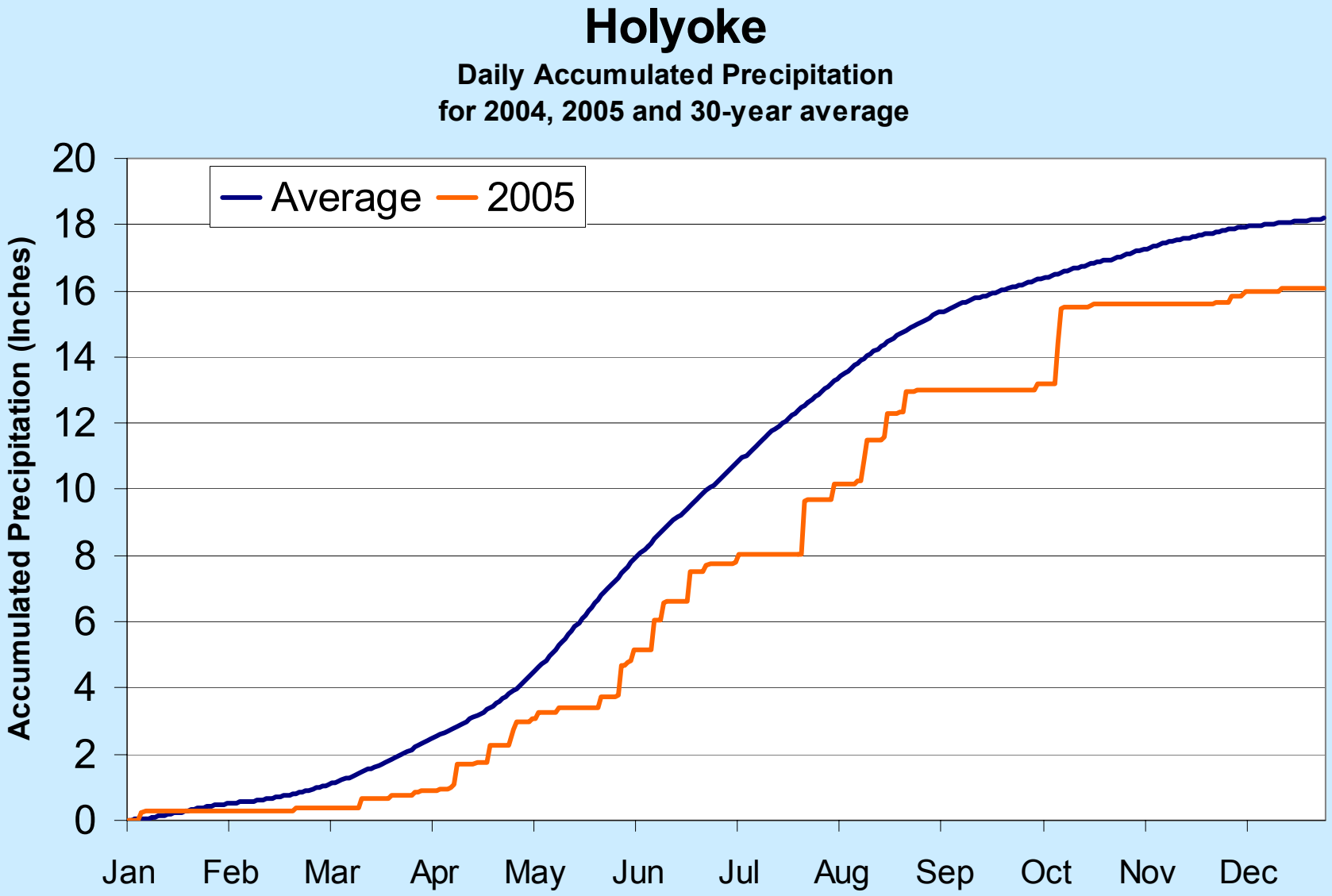


October 2005 precipitation as a percent of the 1971 - 2000 average.

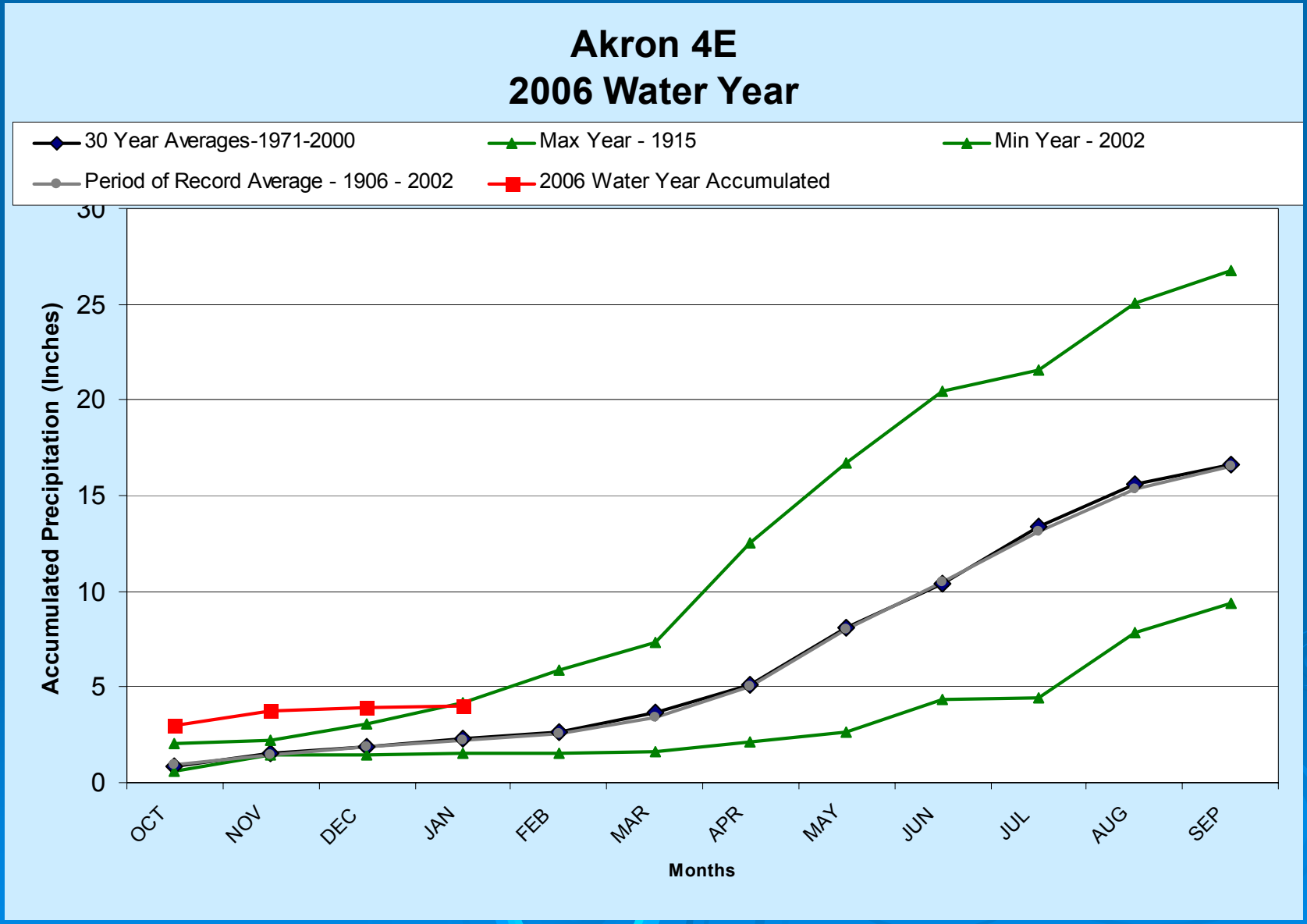
Akron 2005 daily precipitation compared to daily average



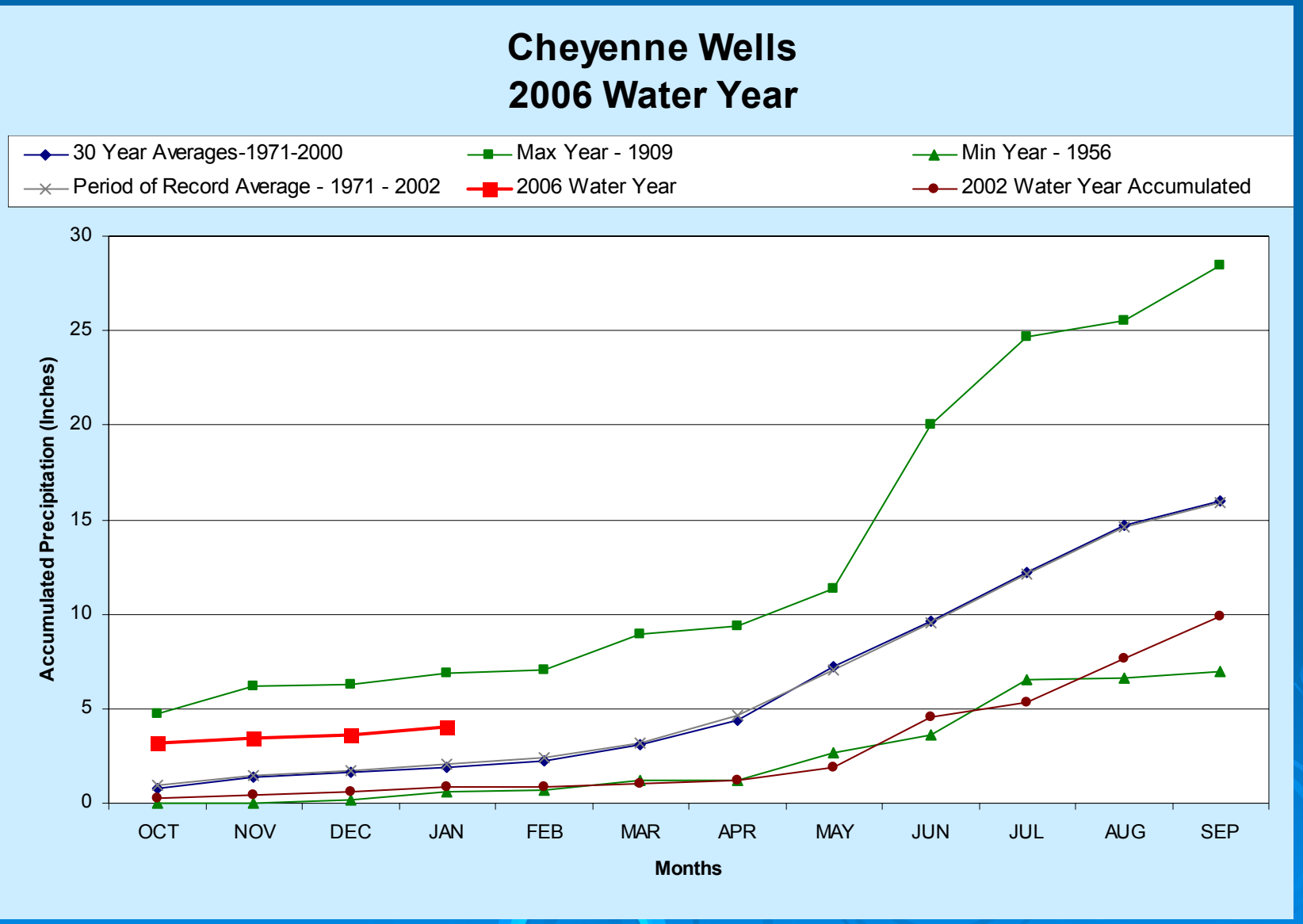
Holyoke, 2004 & 2005 daily accumulated precipitation compared to daily average



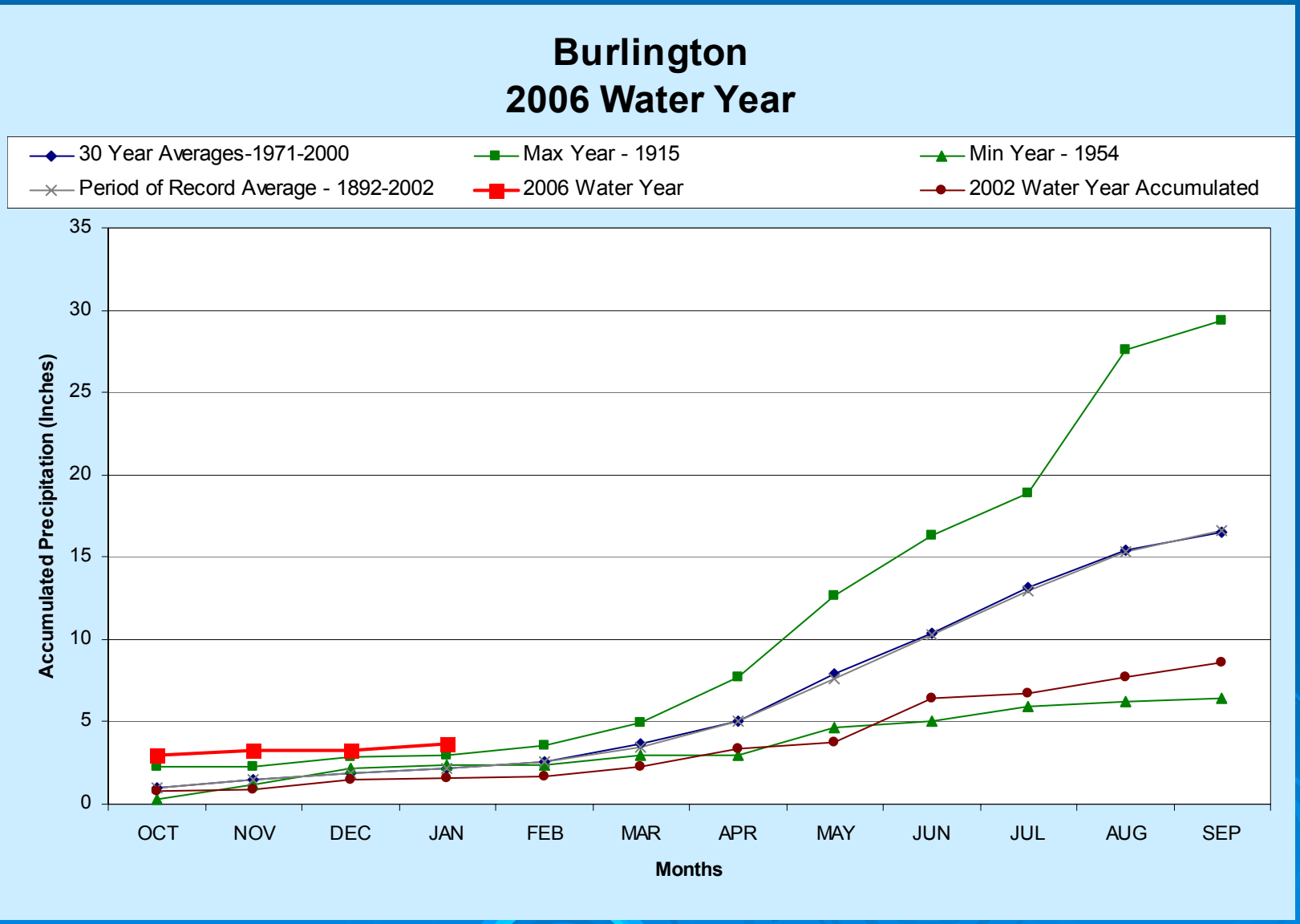
Akron 4E 2006 Water Year



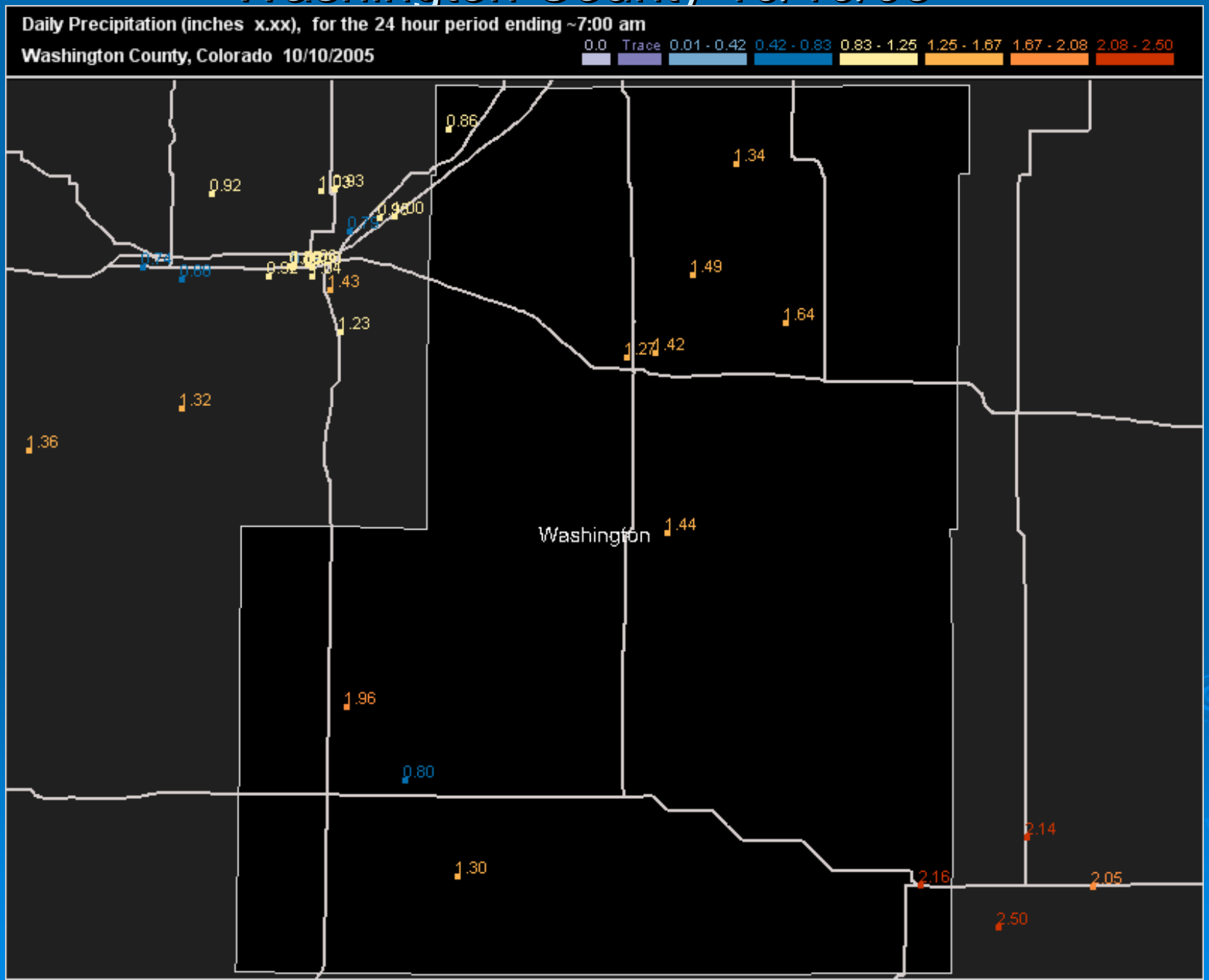
Cheyenne Wells 2006 Water Year



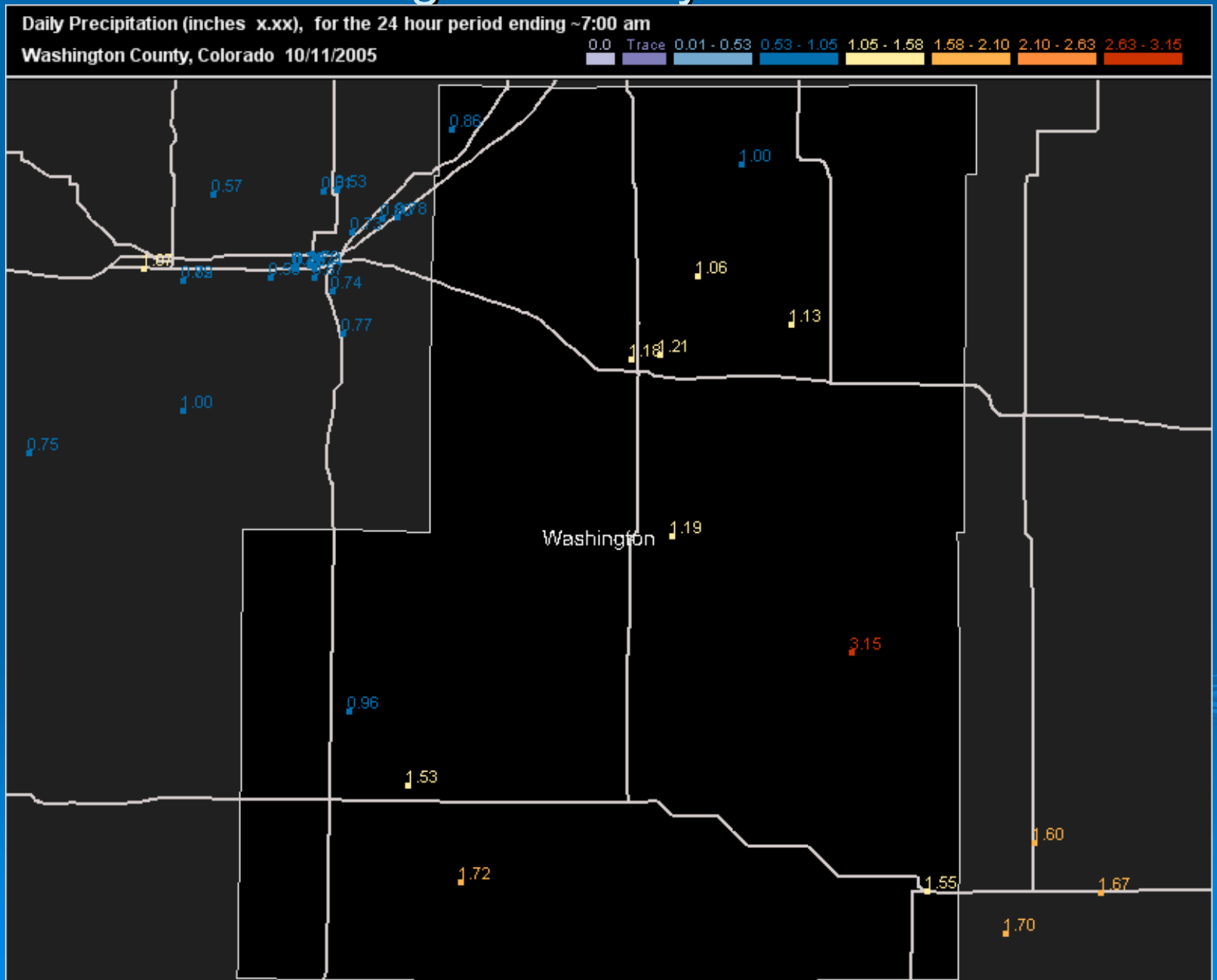
Burlington 2006 Water Year



Washington County 10/10/05



Washington County 10/11/05

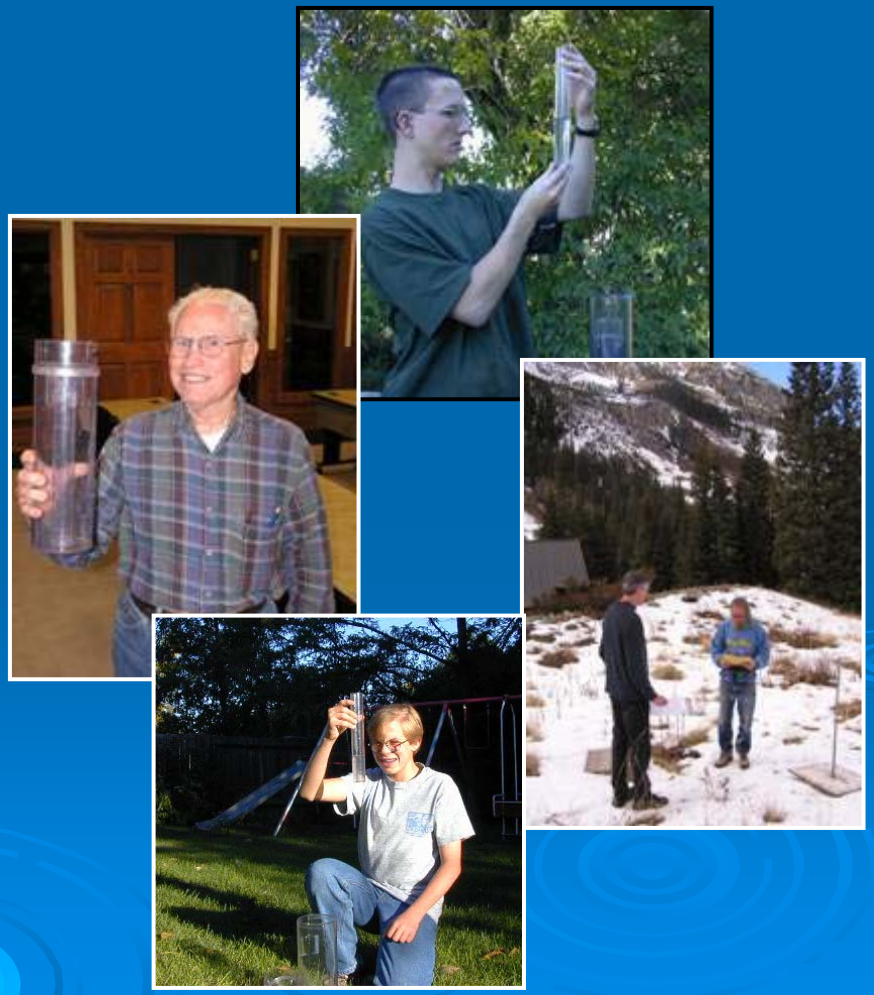


CoCoRaHS
Community Collaborative Rain, Hail & Snow Network
NSF

Precipitation – We could sure use more data!

What is CoCoRaHS?

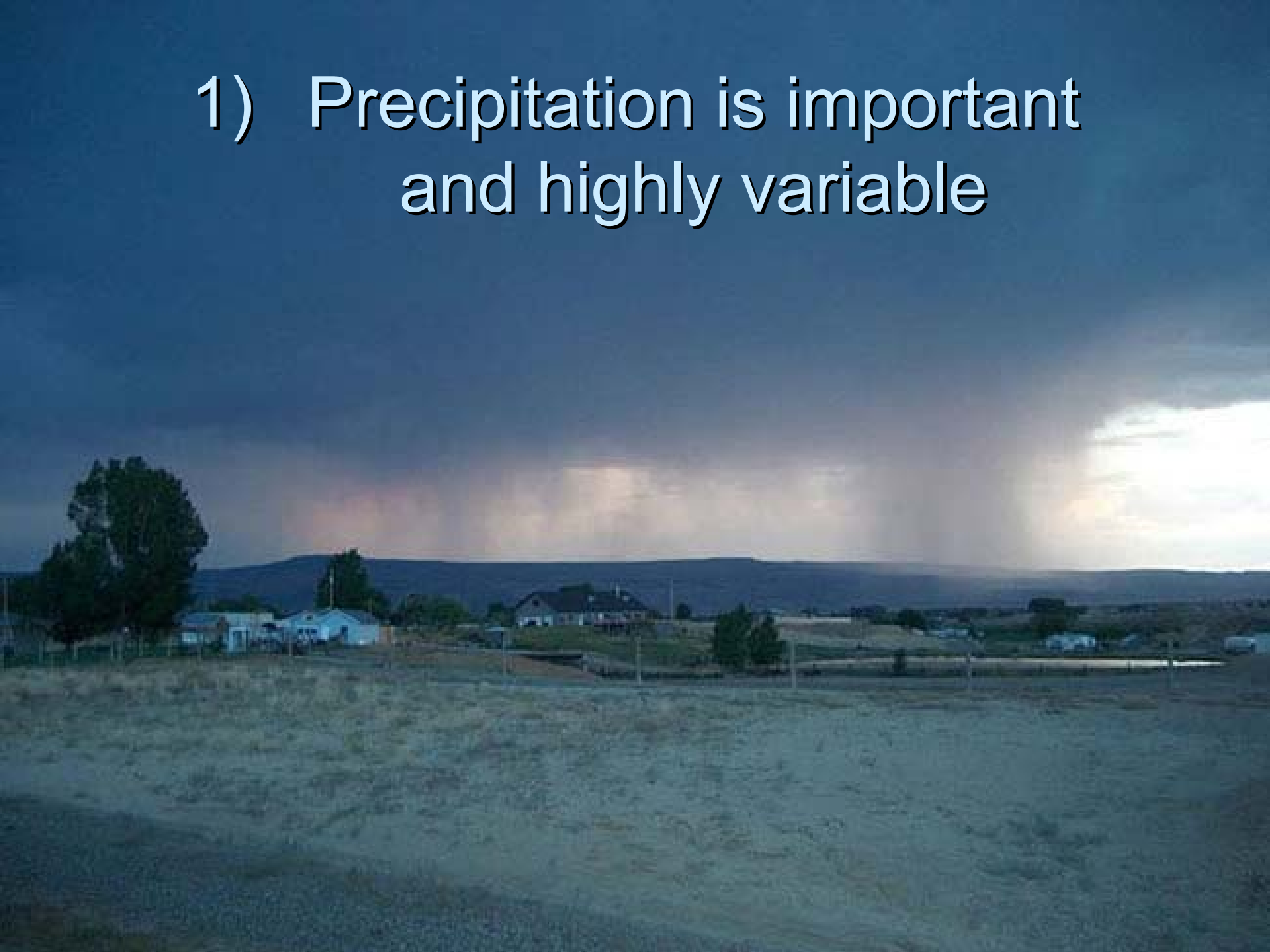
CoCoRaHS is a unique, non-profit community based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow).



“By using low-cost measurement tools, stressing training and education, and utilizing an interactive Web-site, our aim is to provide the highest quality data for natural resource, education and research applications.”

Some reasons for measuring

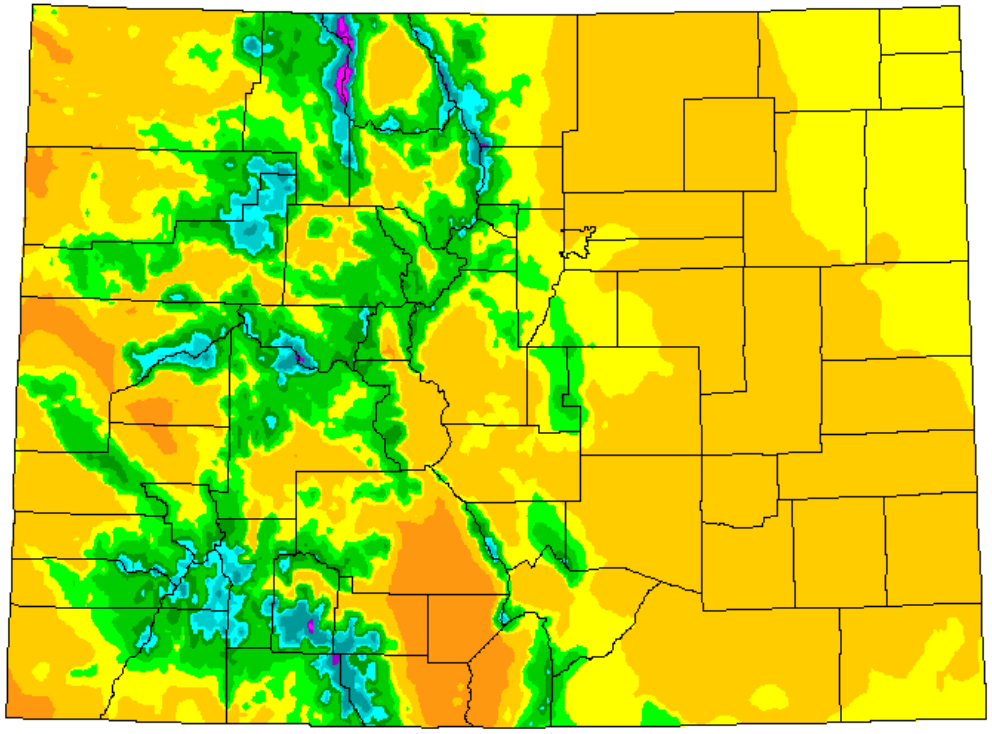
1) Precipitation is important and highly variable



2) Existing weather stations are too far apart

Average Annual Precipitation

Colorado



Legend (in inches)

Under 10	35 to 40
10 to 15	40 to 45
15 to 20	45 to 50
20 to 25	50 to 55
25 to 30	Above 55
30 to 35	

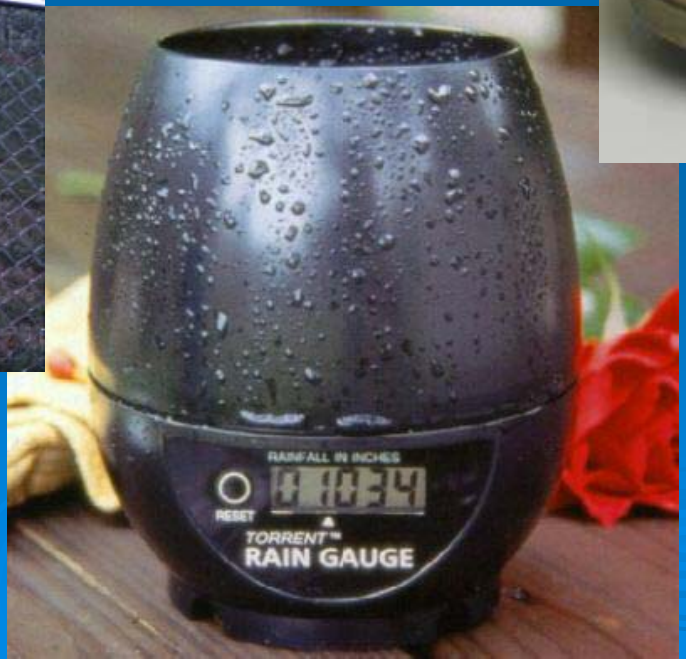
This is a map of annual precipitation averaged over the period 1961-1990. Station observations were collected from the NOAA Cooperative and USDA-NRCS SnoTel networks, plus other state and local networks. The PRISM modeling system was used to create the gridded estimates from which this map was made. The size of each grid pixel is approximately 4x4 km. Support was provided by the NRCS Water and Climate Center.

For information on the PRISM modeling system, visit the SCAS web site at http://www.ocs.orst.edu/prism

The latest PRISM digital data sets created by the SCAS can be obtained from the Climate Source at http://www.climatesource.com

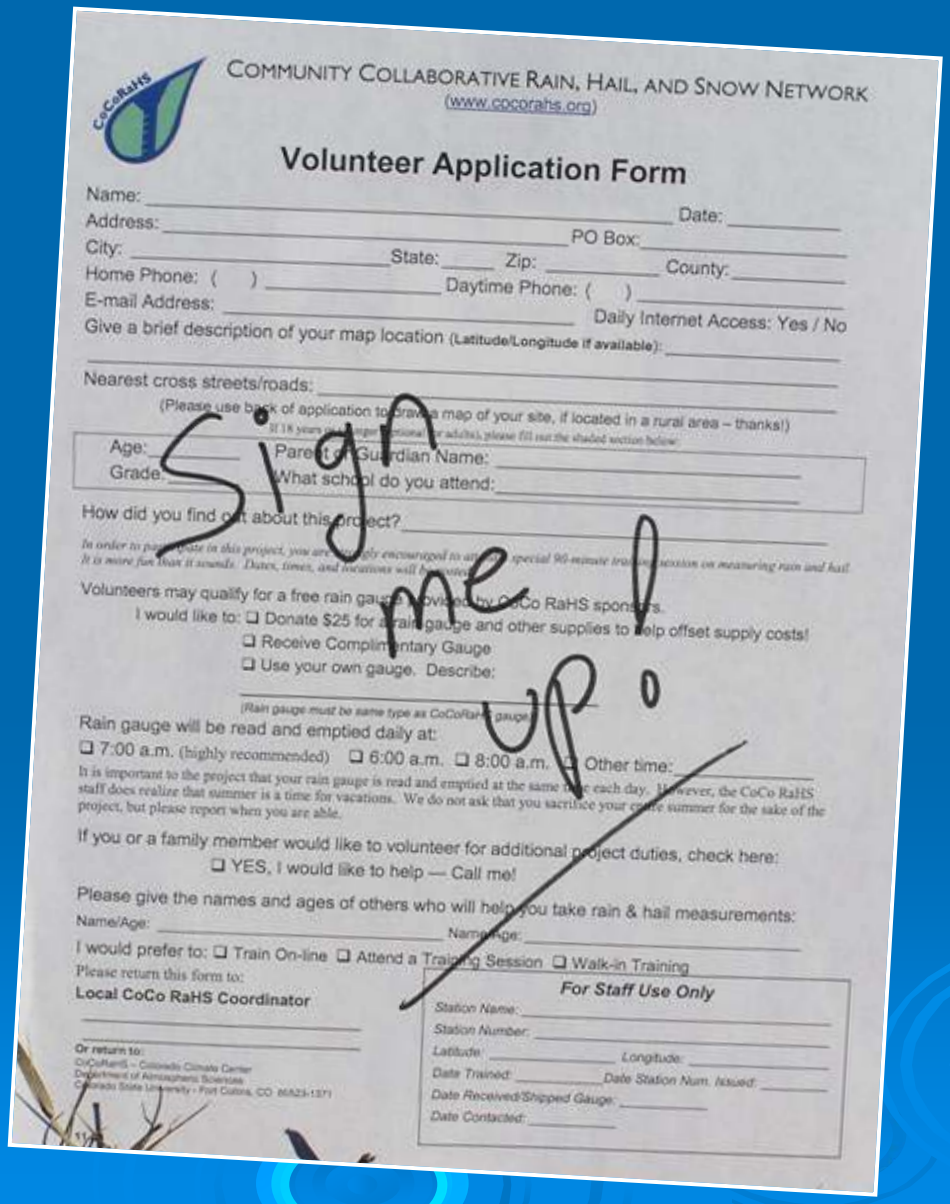
Copyright 2000 by Spatial Climate Analysis Service, Oregon State University

3) Electronic measurements of precipitation are unsatisfactory



4) Storm reports can save lives

What's Involved?



COMMUNITY COLLABORATIVE RAIN, HAIL, AND SNOW NETWORK
(www.cocorahs.org)

Volunteer Application Form

Name: _____ Date: _____
Address: _____ PO Box: _____
City: _____ State: _____ Zip: _____ County: _____
Home Phone: ( ) _____ Daytime Phone: ( ) _____
E-mail Address: _____ Daily Internet Access: Yes / No
Give a brief description of your map location (Latitude/Longitude if available): _____
Nearest cross streets/roads: _____
(Please use back of application to draw a map of your site, if located in a rural area – thanks!)
(If 18 years of age or younger (optional for adults), please fill out the shaded section below)
Age: _____ Parent or Guardian Name: _____
Grade: _____ What school do you attend: _____
How did you find out about this project? _____
In order to participate in this project, you are strongly encouraged to attend a special 90-minute training session on measuring rain and hail. It is more fun than it sounds. Dates, times, and locations will be announced.
Volunteers may qualify for a free rain gauge provided by CoCo RaHS sponsors.
I would like to: ❑ Donate $25 for a rain gauge and other supplies to help offset supply costs!
❑ Receive Complimentary Gauge
❑ Use your own gauge. Describe: _____
(Rain gauge must be same type as CoCoRaHS gauge)
Rain gauge will be read and emptied daily at:
❑ 7:00 a.m. (highly recommended) ❑ 6:00 a.m. ❑ 8:00 a.m. ❑ Other time: _____
It is important to the project that your rain gauge is read and emptied at the same time each day. However, the CoCo RaHS staff does realize that summer is a time for vacations. We do not ask that you sacrifice your entire summer for the sake of the project, but please report when you are able.
If you or a family member would like to volunteer for additional project duties, check here:
❑ YES, I would like to help — Call me!
Please give the names and ages of others who will help you take rain & hail measurements:
Name/Age: _____ Name/Age: _____
I would prefer to: ❑ Train On-line ❑ Attend a Training Session ❑ Walk-in Training
Please return this form to:
Local CoCo RaHS Coordinator
_____
_____
Or return to:
CoCoRaHS – Colorado Climate Center
Department of Atmospheric Science
Colorado State University - Fort Collins, CO 80523-1371

For Staff Use Only
Station Name: _____
Station Number: _____
Latitude: _____ Longitude: _____
Date Trained: _____ Date Station Num. Issued: _____
Date Received/Shipped Gauge: _____
Date Contacted: _____

Sign me up!

How to sign up?

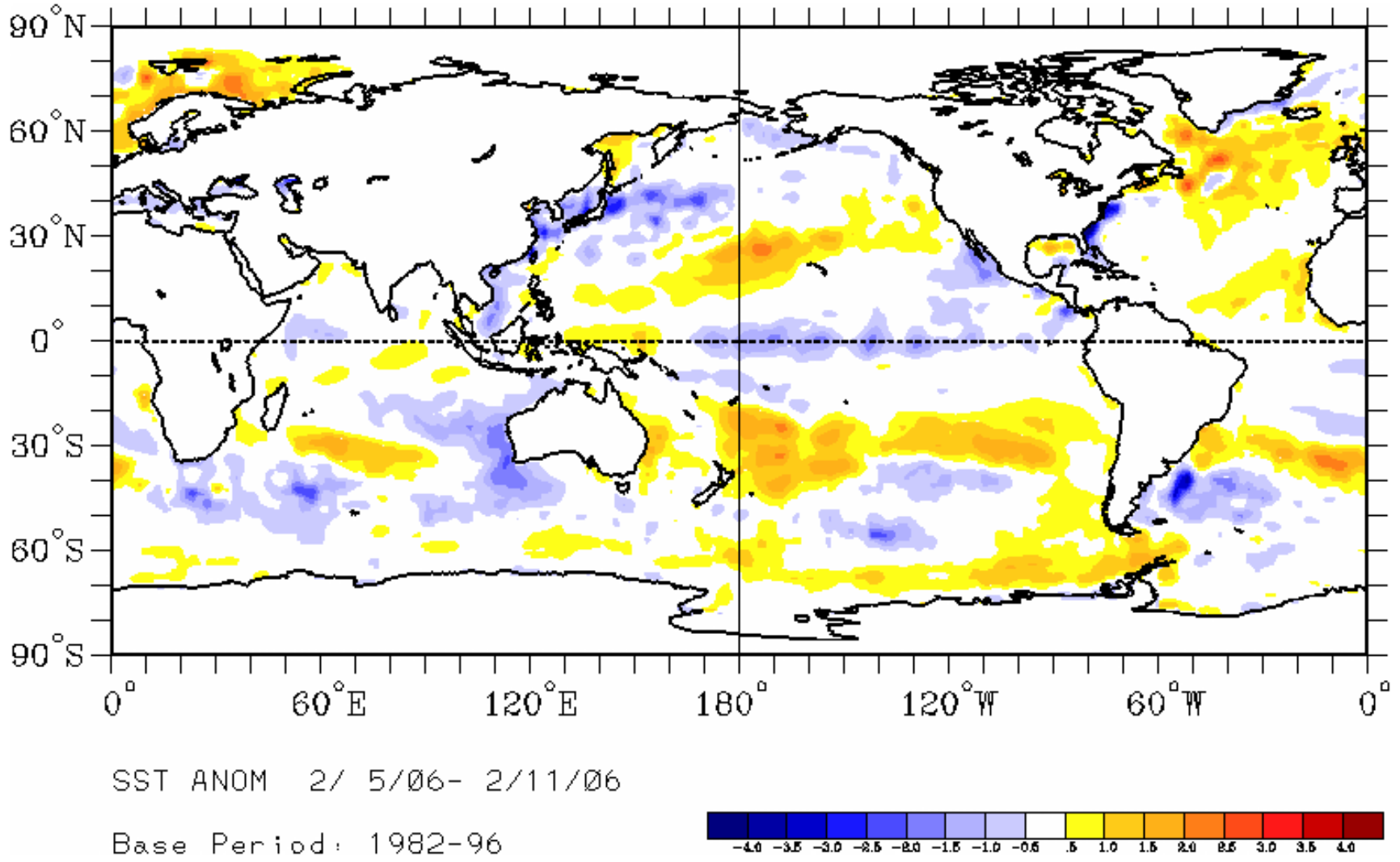
- See Me after talk

  or
- Fill out application at CoCoRaHS display

  or
- Fill out “Join Us” form online at www.cocorahs.org

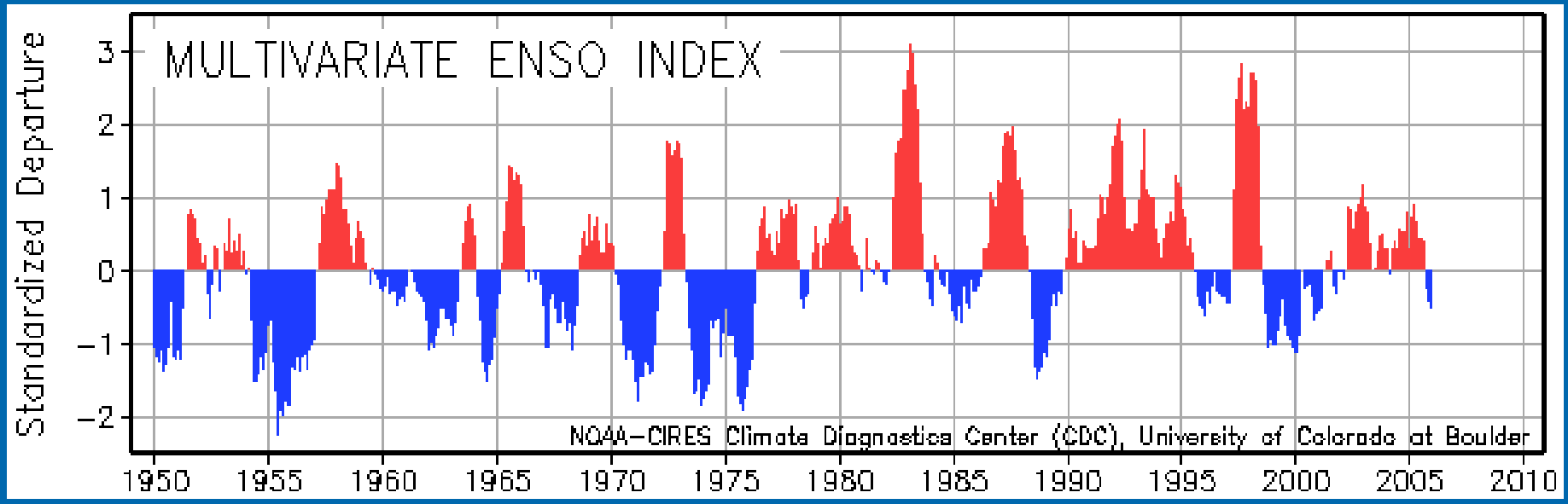
Finally, what's ahead for this Spring and Summer?

Sea Surface Temperature Anomaly



http://www.cdc.noaa.gov/map/clim/sst.shtml

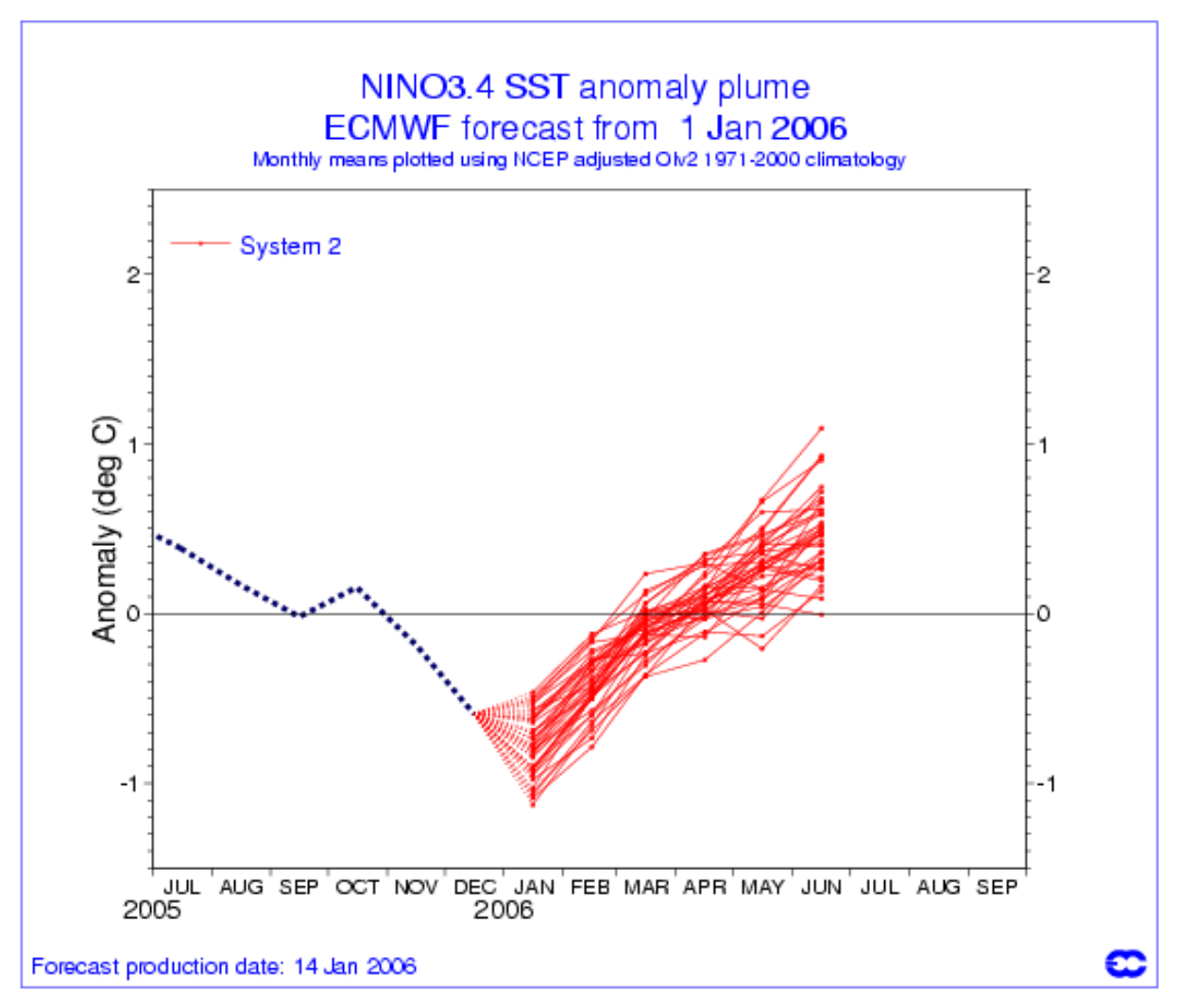
Multivariate ENSO Index (MEI)



Last update: February 6, 2006

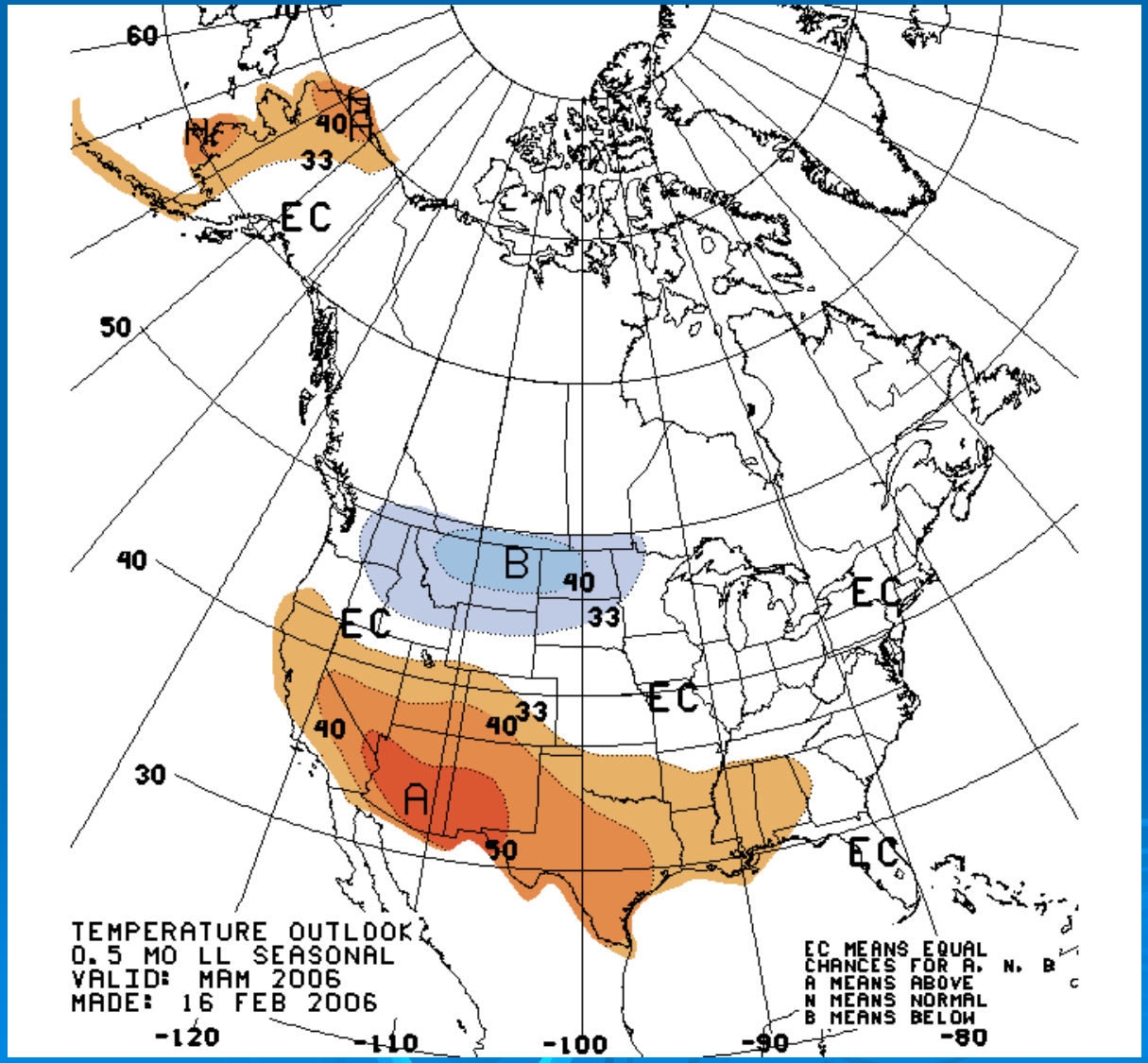
http://www.cdc.noaa.gov/people/klaus.wolter/MEI/

El Nino Forecast



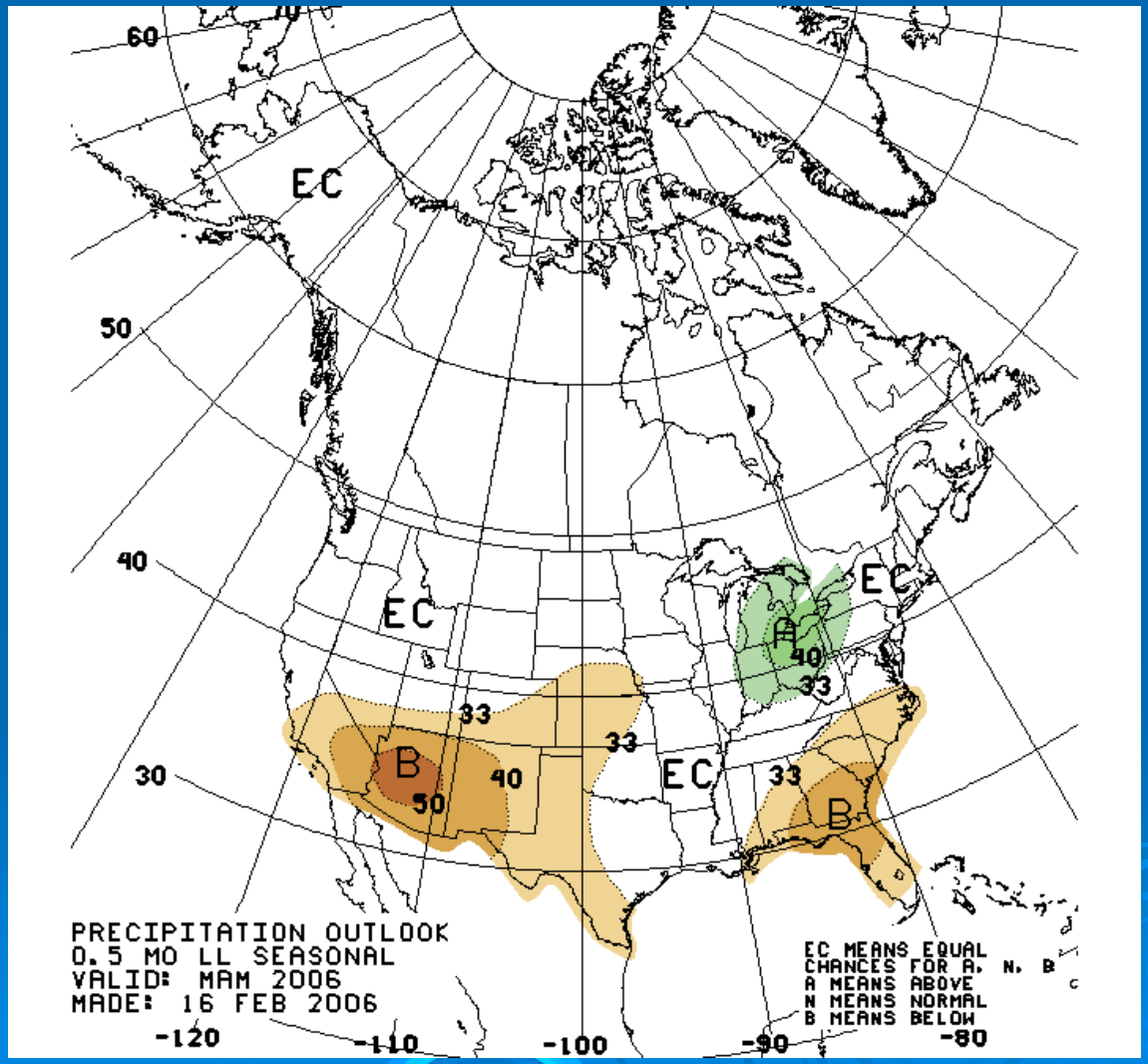
http://www.cdc.noaa.gov/people/klaus.wolter/SWcasts/

Temperature
Mar-May 2006



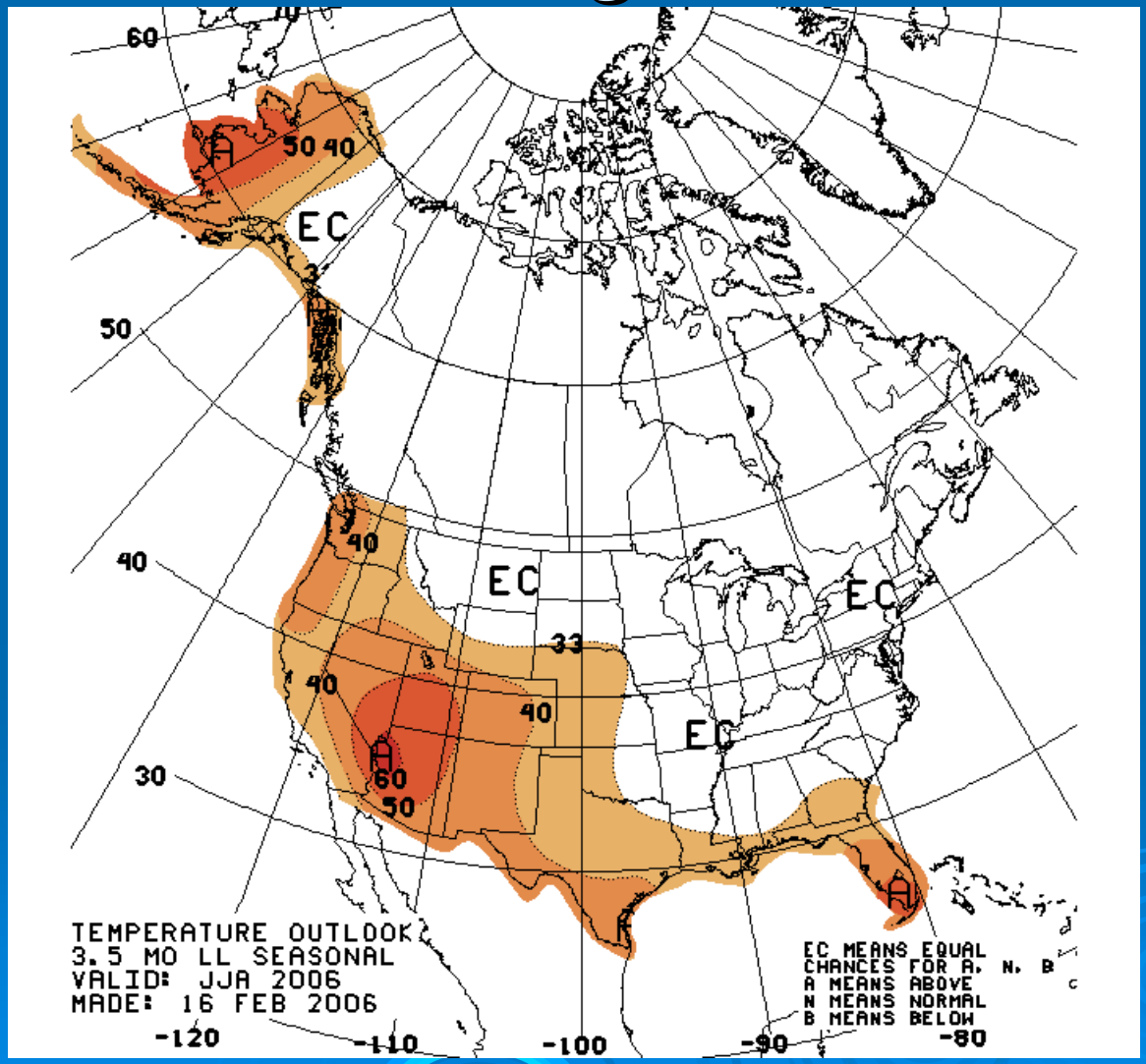
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Precipitation
Mar-May 2006



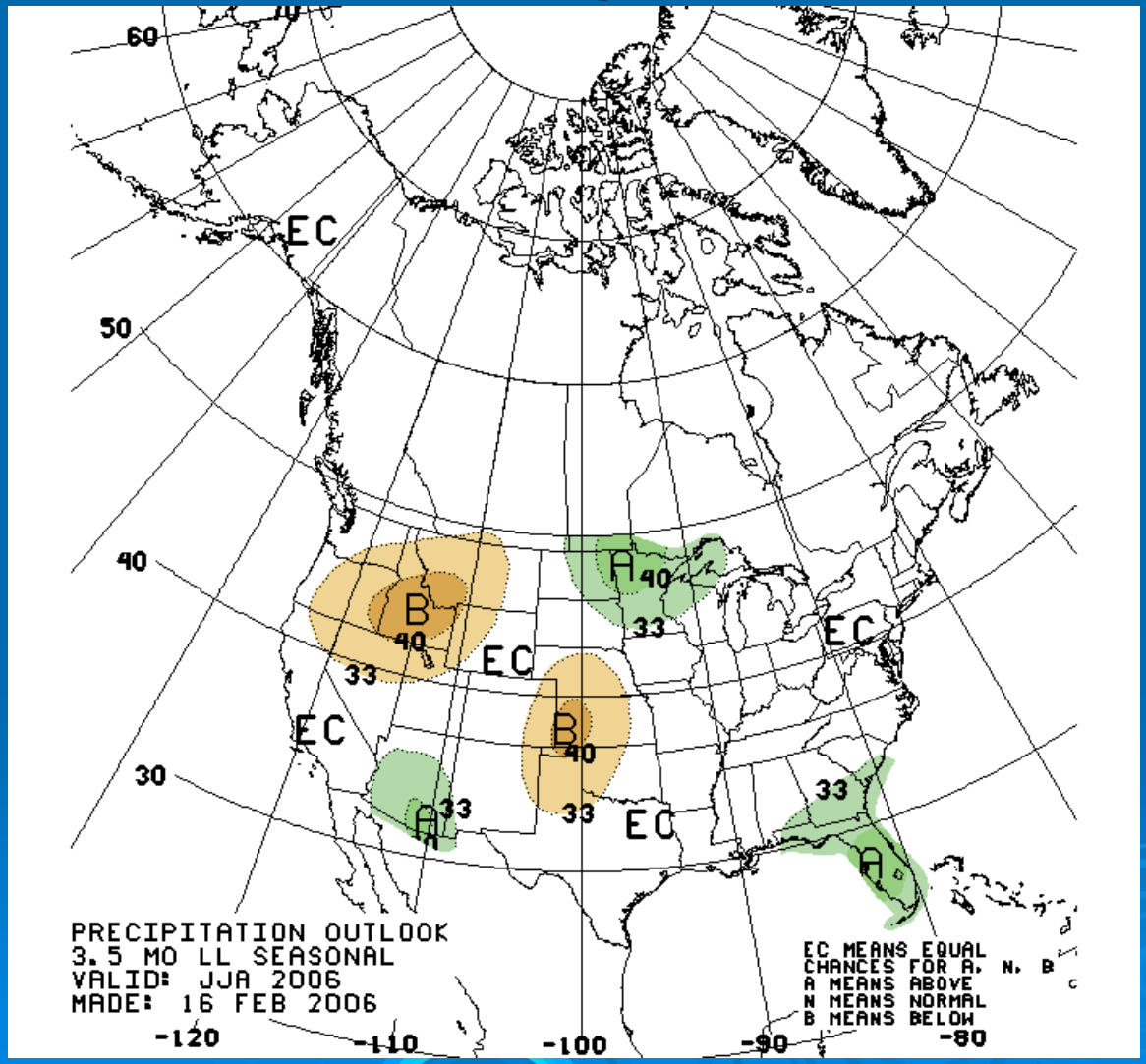
From the Colorado Prediction Center
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Temperature
Jun-Aug 2006



From the Colorado Prediction Center
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

Precipitation
Jun-Aug 2006

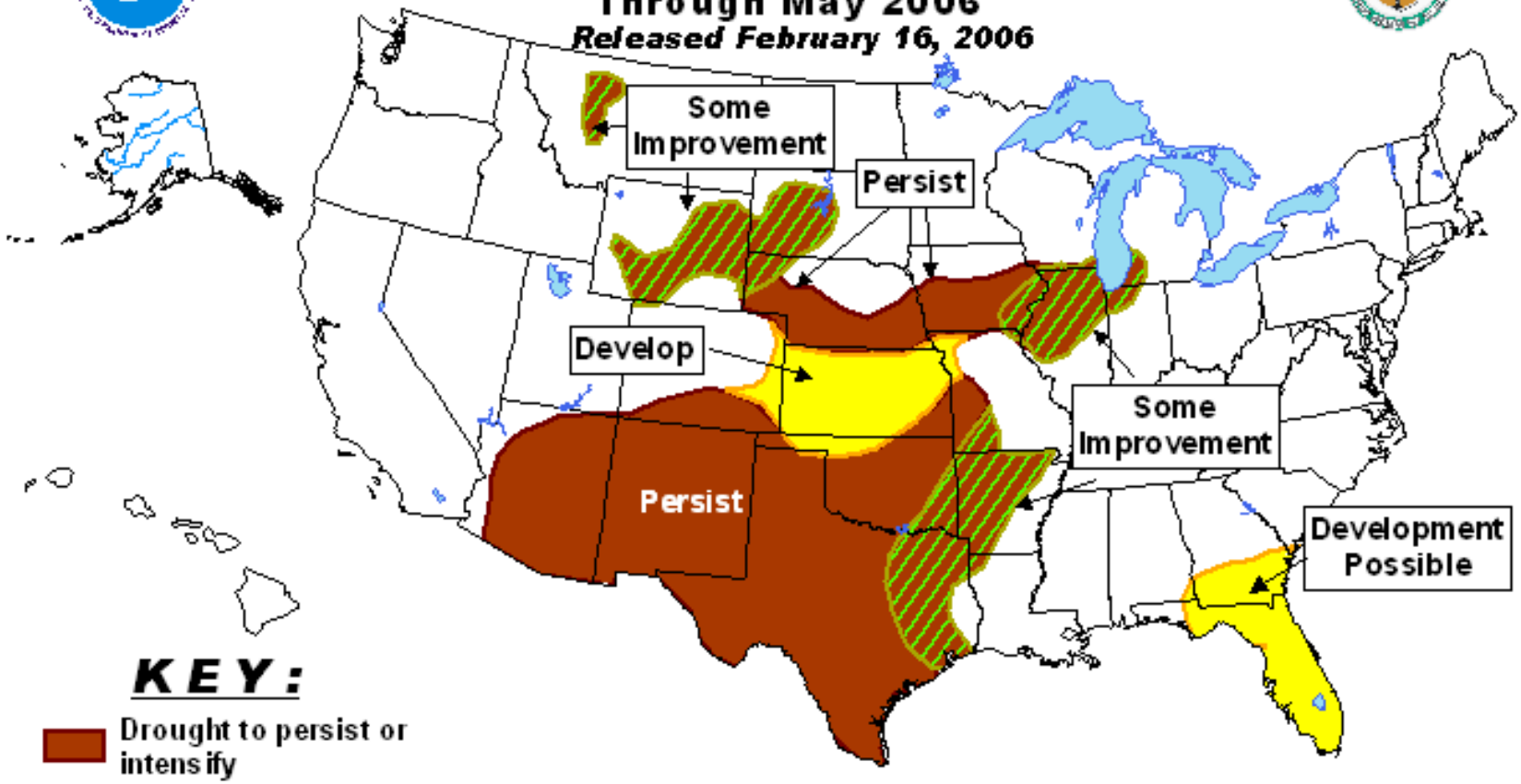


From the Colorado Prediction Center
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

U.S. Seasonal Drought Outlook

Through May 2006

Released February 16, 2006

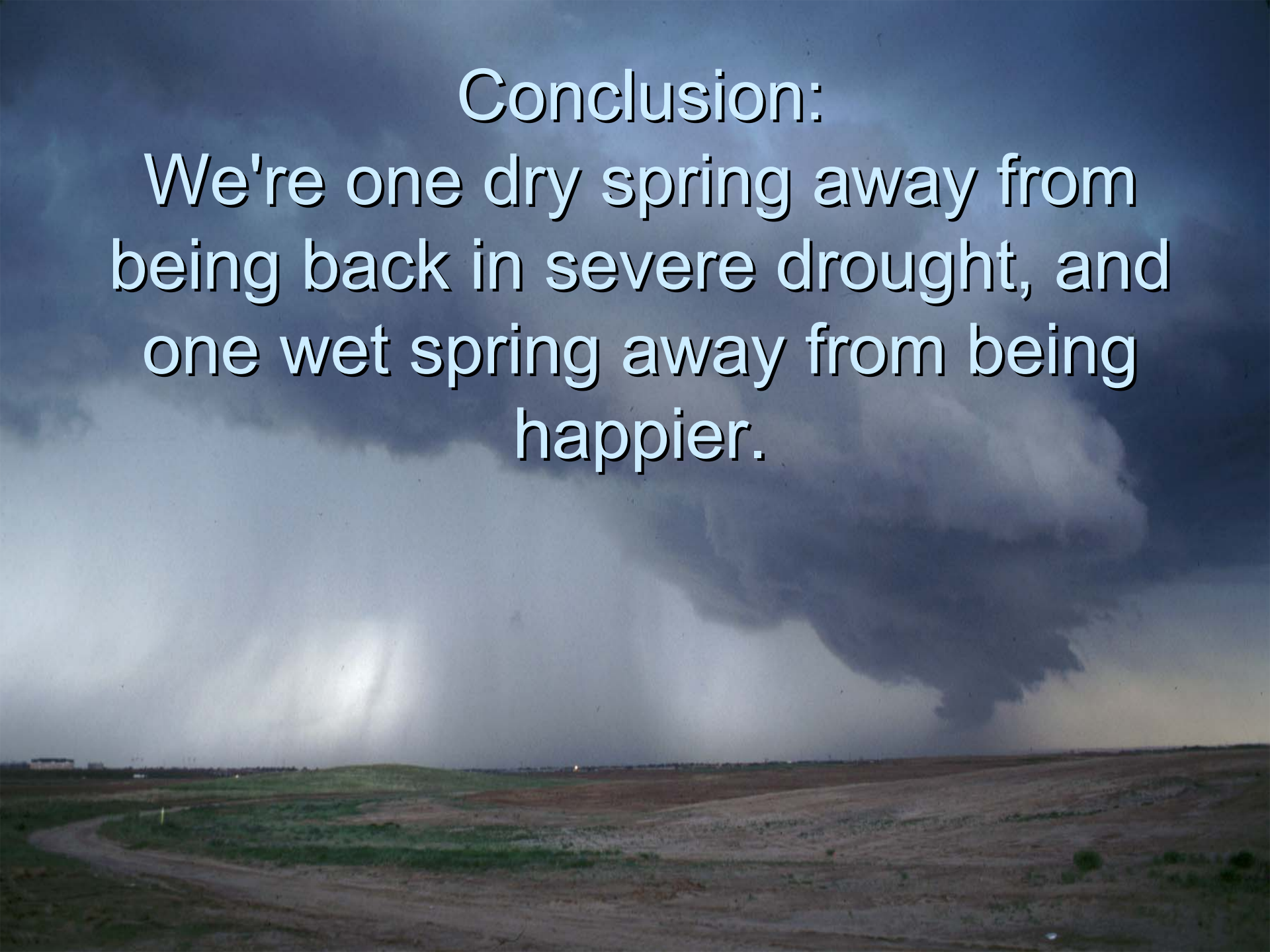


KEY:

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts general, large-scale trends based on subjectively derived probabilities guided by numerous indicators, including short- and long-range statistical and dynamical forecasts. Short-term events -- such as individual storms -- cannot be accurately forecast more that a few days in advance, so use caution if using this outlook for applications -- such as crops -- that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4). For weekly drought updates, see the latest Drought Monitor map and text. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

http://www.cpc.ncep.noaa.gov/products/expert_assessment/seasonal_drought.html



Conclusion:

We're one dry spring away from being back in severe drought, and one wet spring away from being happier.

But in this land, any drought recovery is temporary.
15-18" of moisture is a lot better than nothing, but it doesn't leave you any margin.

Colorado Climate Center
Colorado State University

- Data and Power Point Presentations available for downloading

- **http://ccc.atmos.colostate.edu**

  click on “Drought”

  then click on “Presentations”