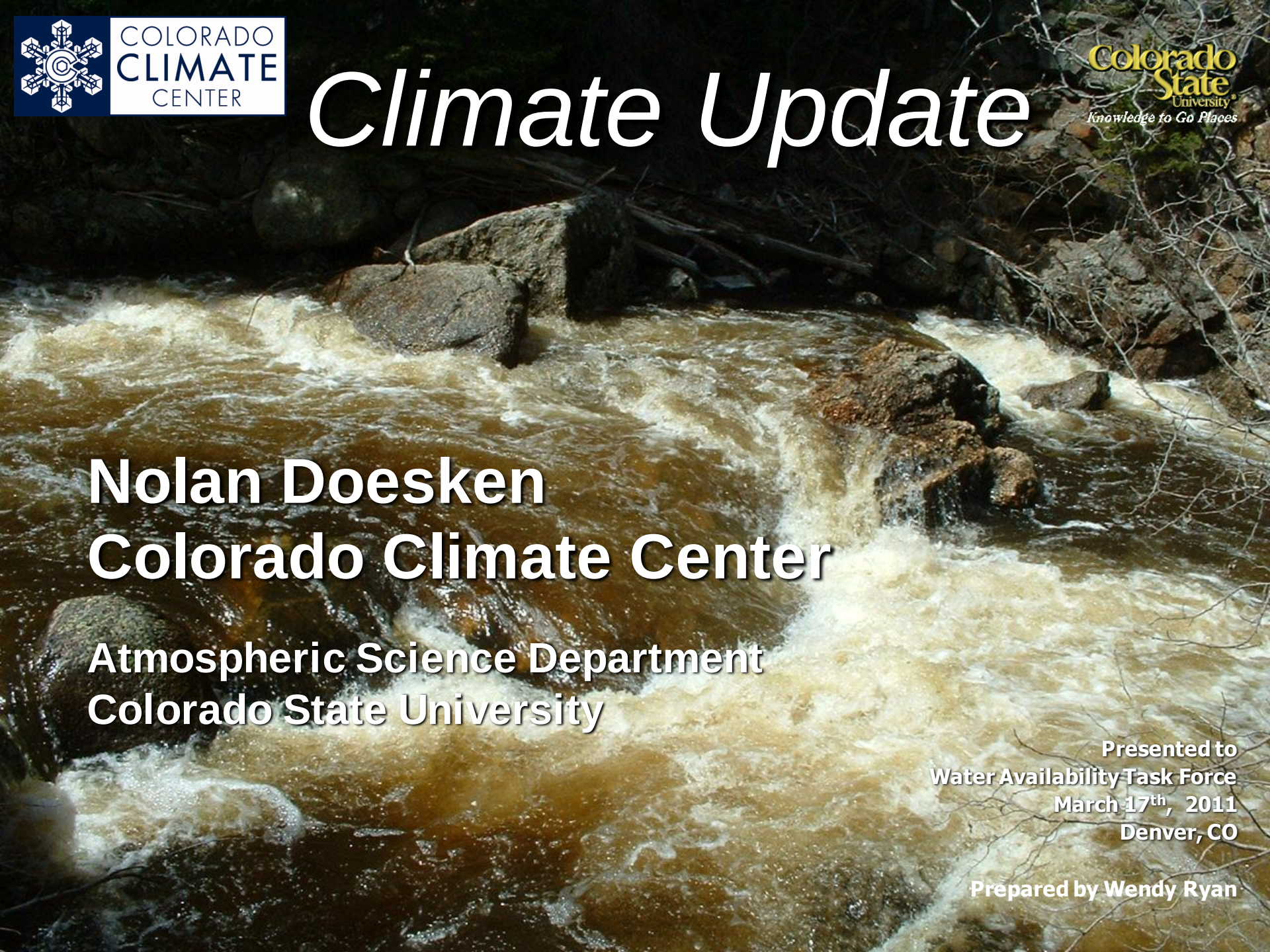


Climate Update

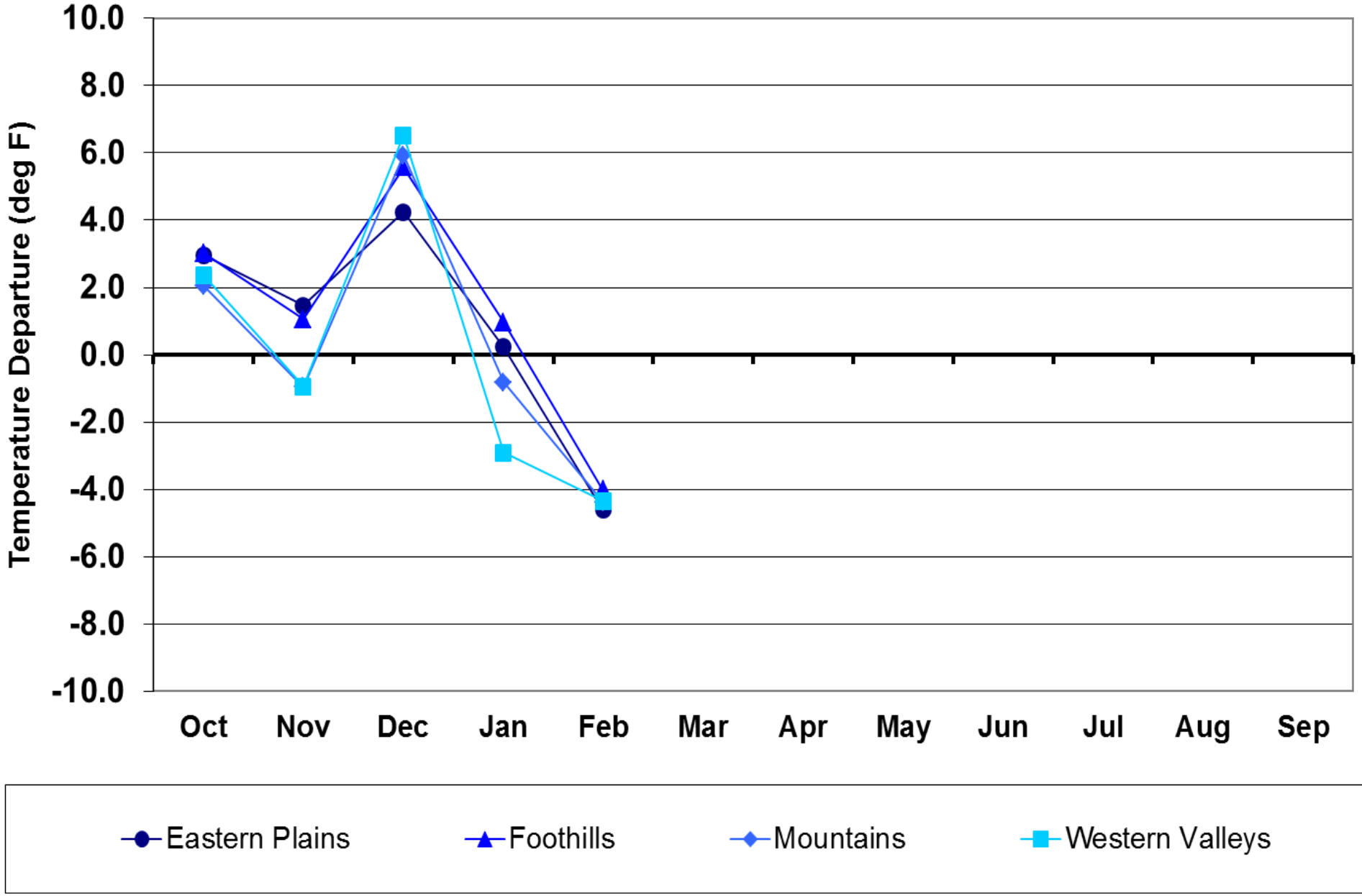
Nolan Doesken
Colorado Climate Center

Atmospheric Science Department
Colorado State University

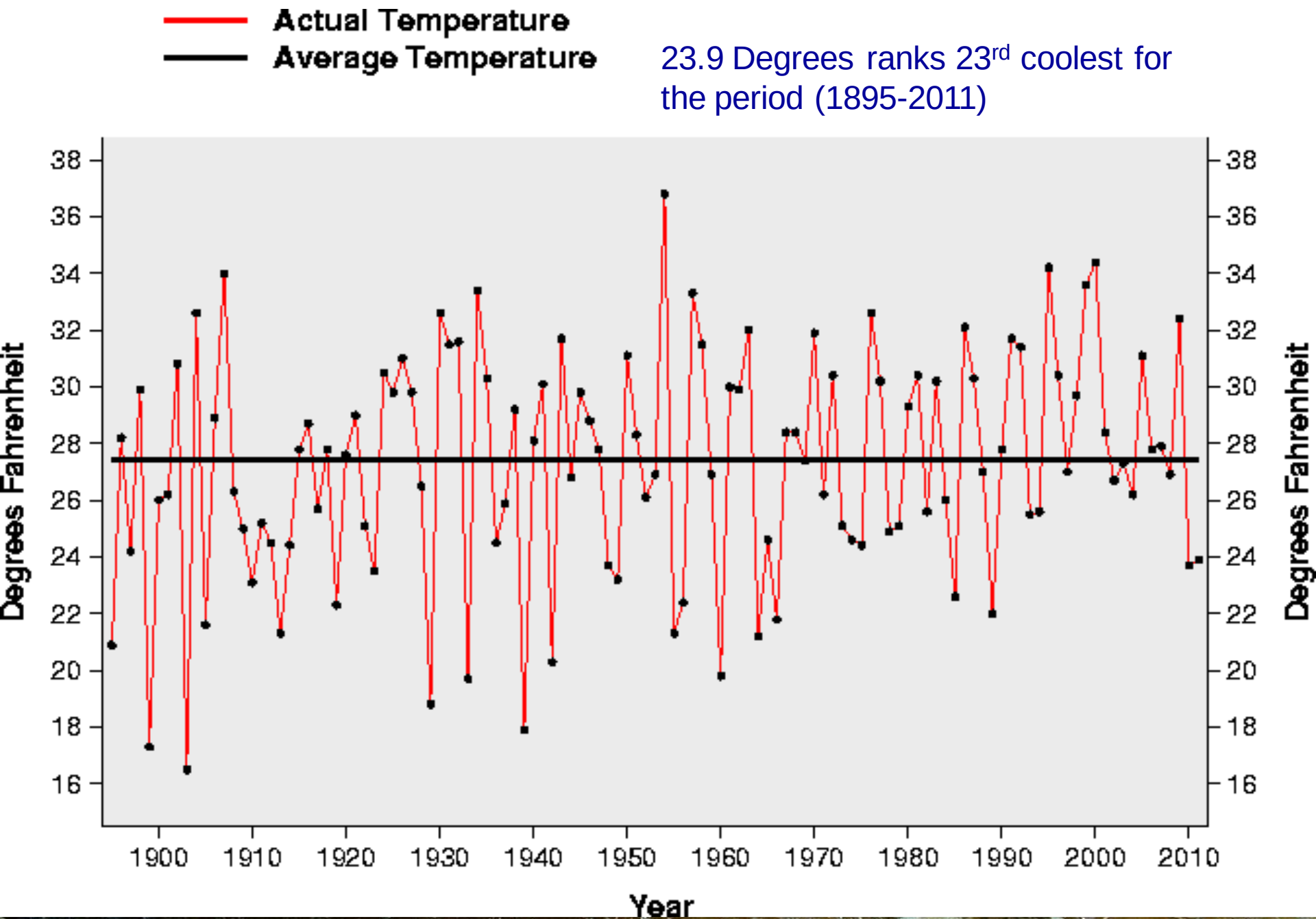
Presented to
Water Availability Task Force
March 17th, 2011
Denver, CO

Prepared by Wendy Ryan

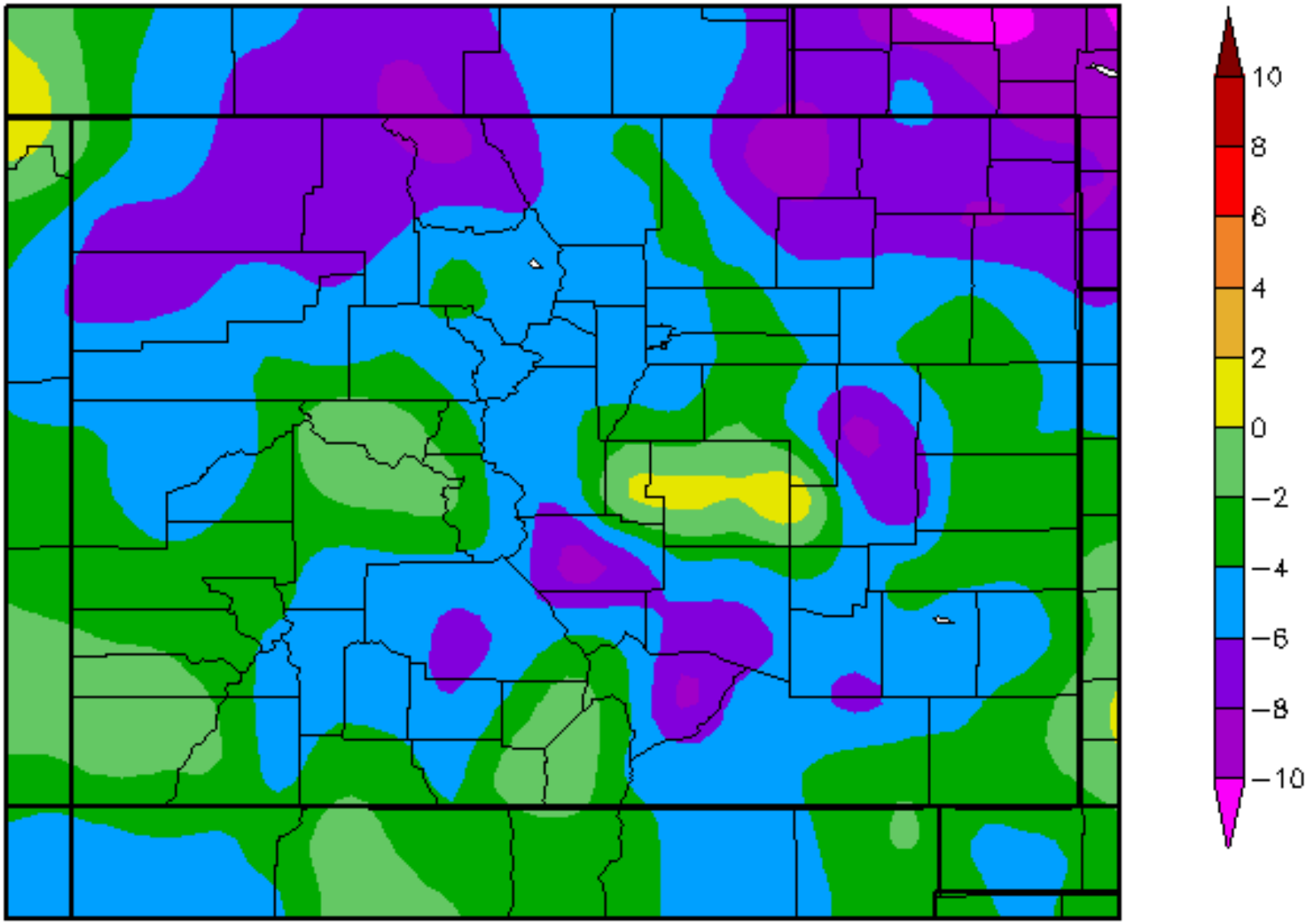
Water Year 2011 Temperature Departures



February Average Temperature History for Colorado (NCDC)



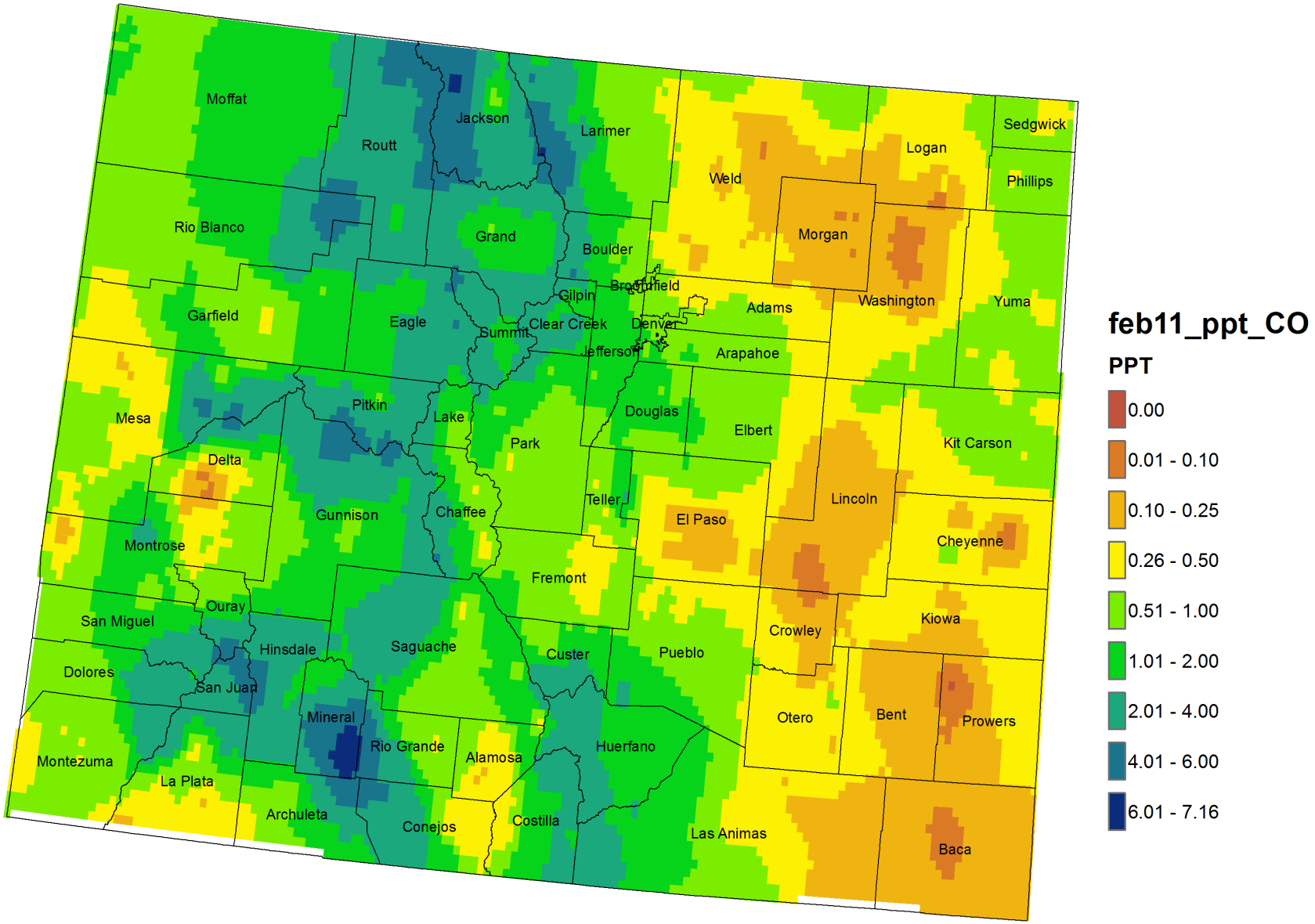
Departure from Normal Temperature (F)
2/1/2011 – 2/28/2011



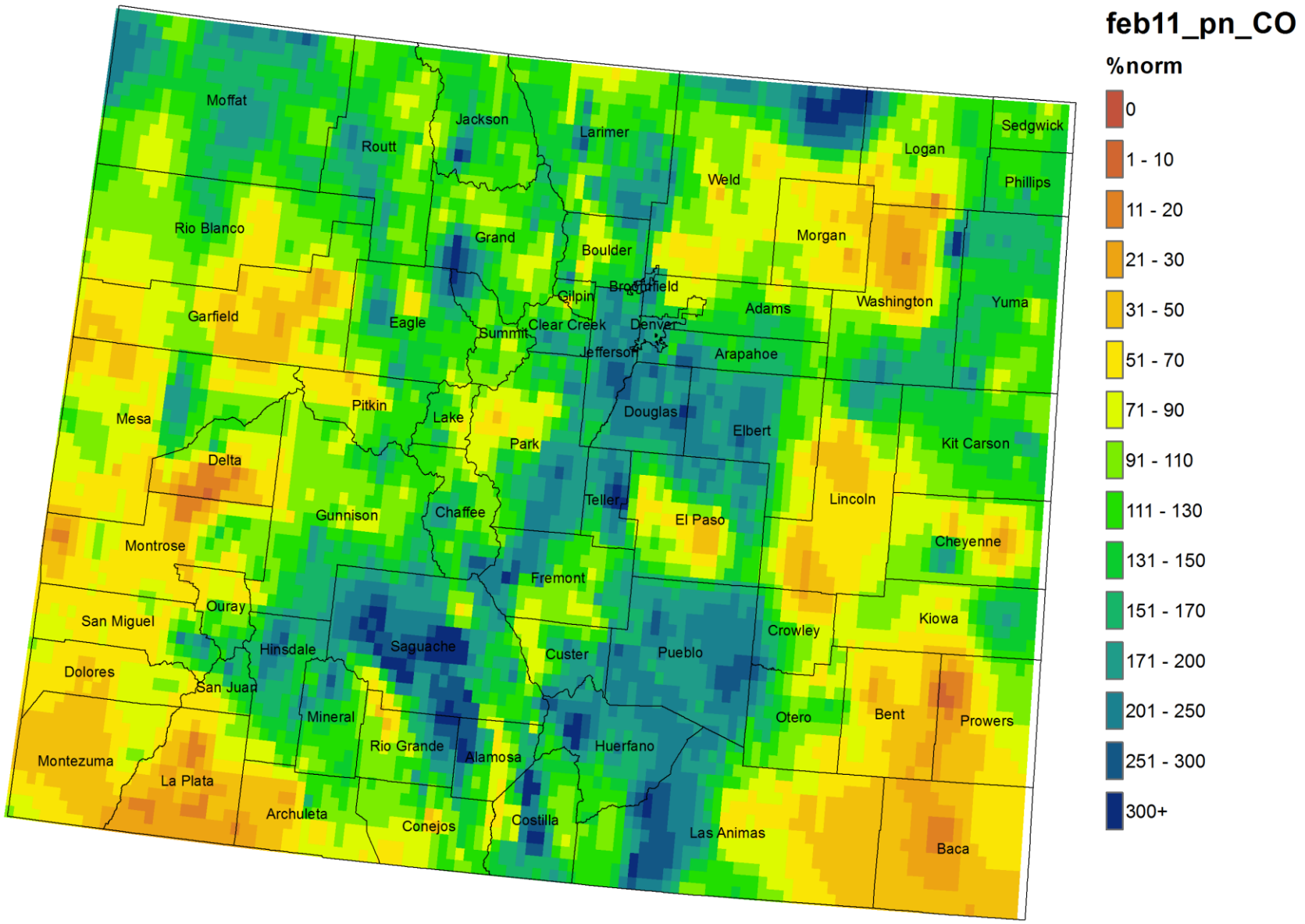
Generated 3/11/2011 at HPRCC using provisional data.

Regional Climate Centers

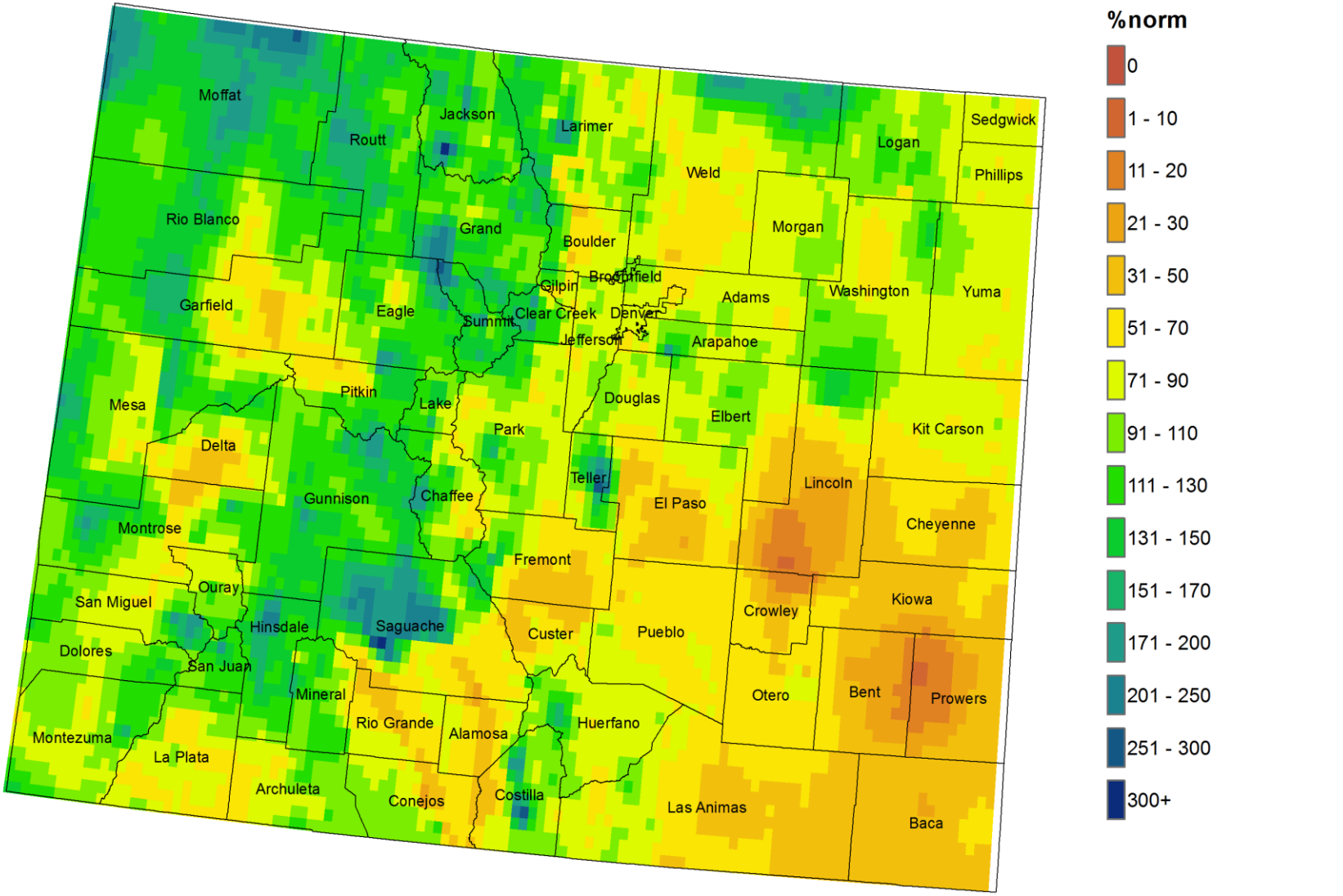
Colorado February Precipitation (in)



Colorado February Precipitation as Percentage of Normal



Colorado Water Year 2011 Precipitation as Percentage of Normal (Oct 10 - Feb 11)

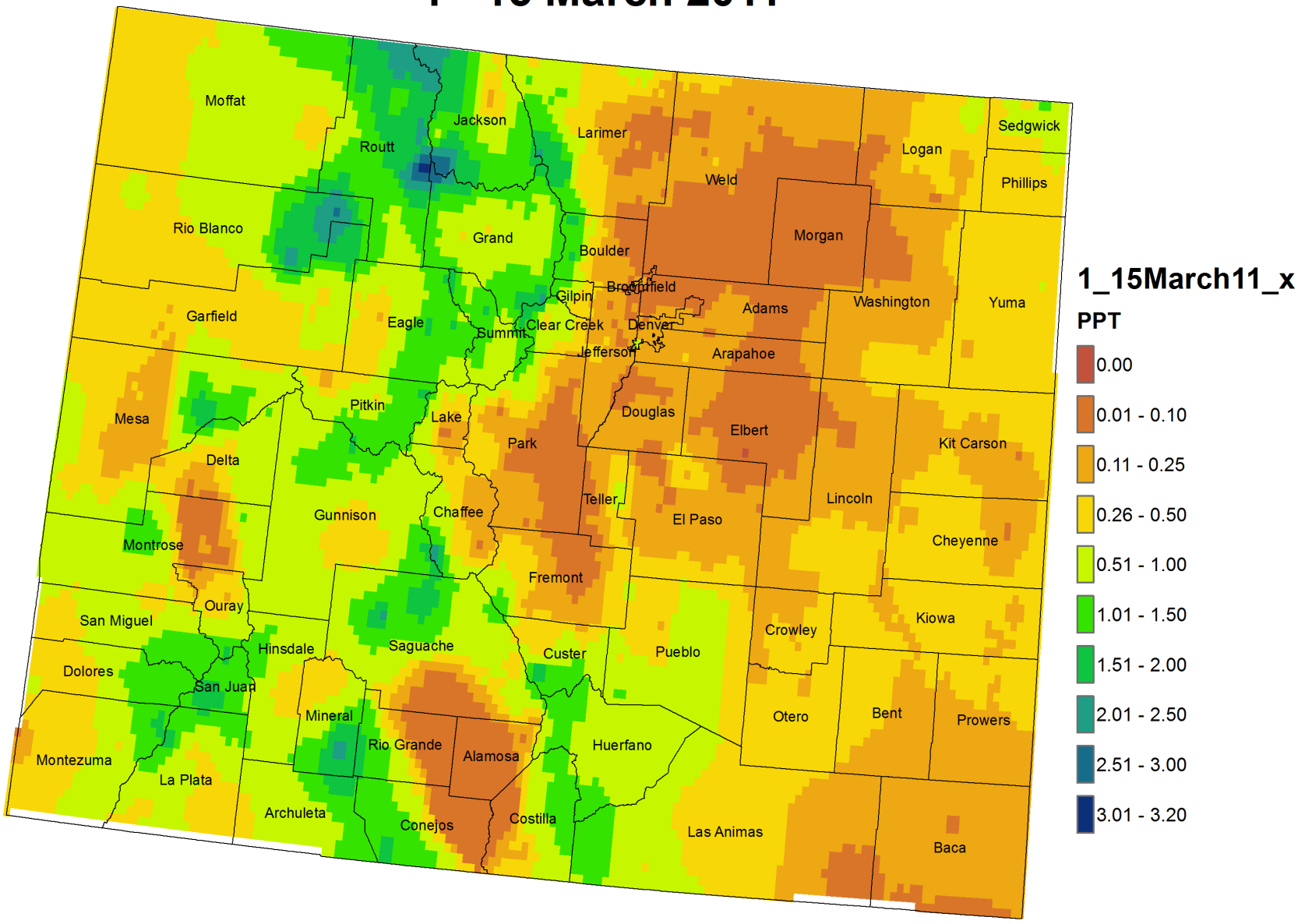


awy_feb_pn_co

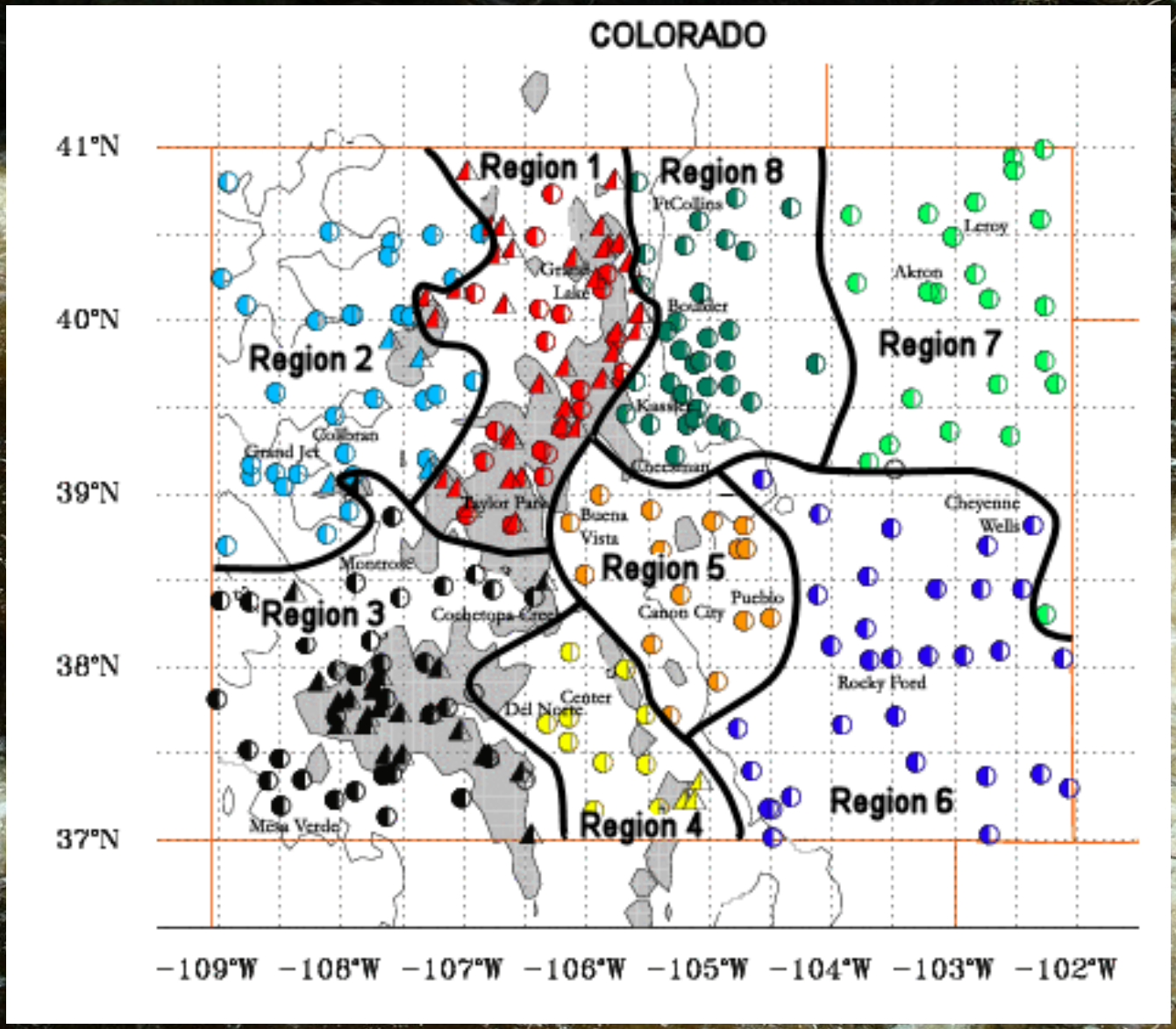
%norm

- 0
- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 50
- 51 - 70
- 71 - 90
- 91 - 110
- 111 - 130
- 131 - 150
- 151 - 170
- 171 - 200
- 201 - 250
- 251 - 300
- 300+

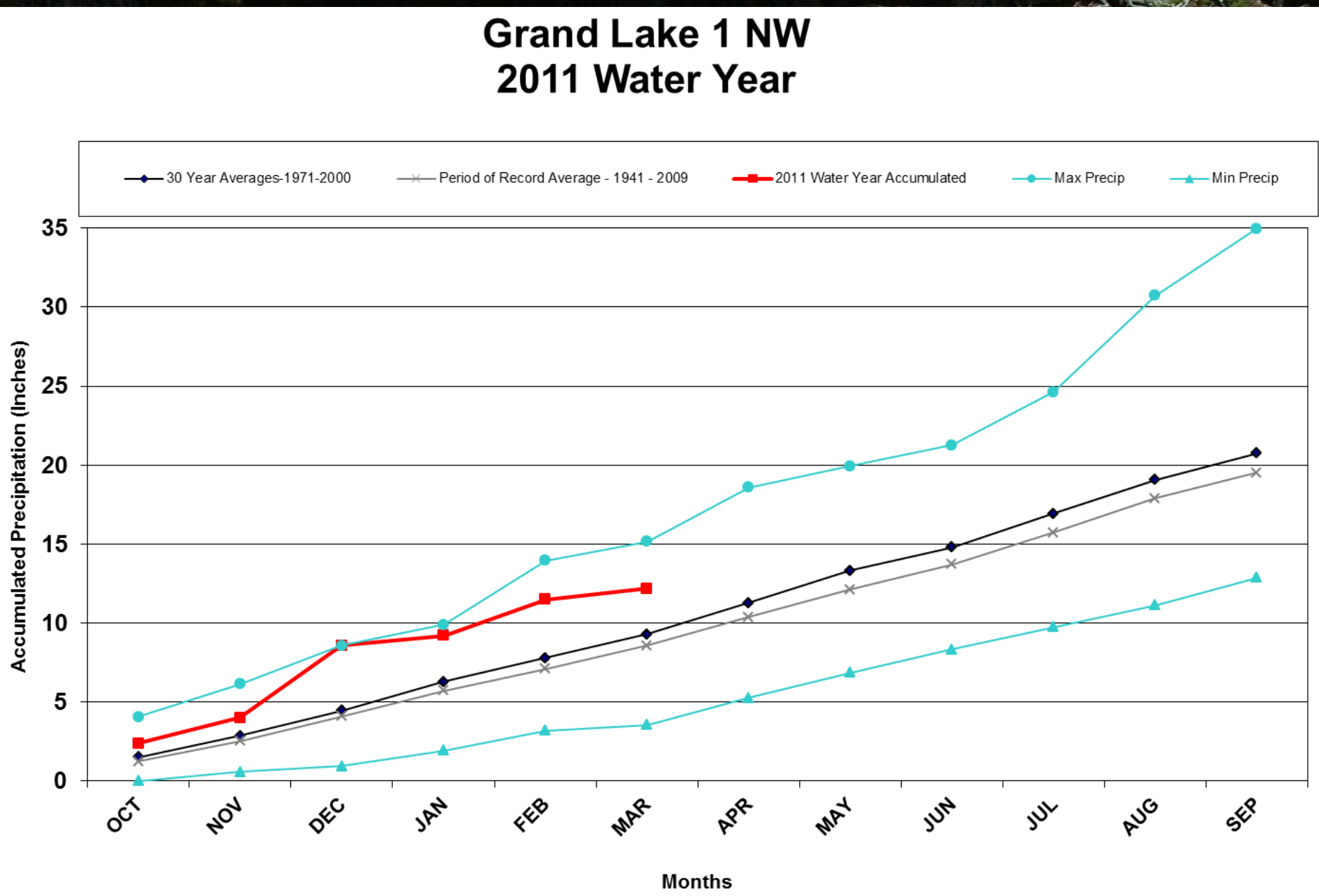
Colorado March Precipitation (in)
1 - 15 March 2011



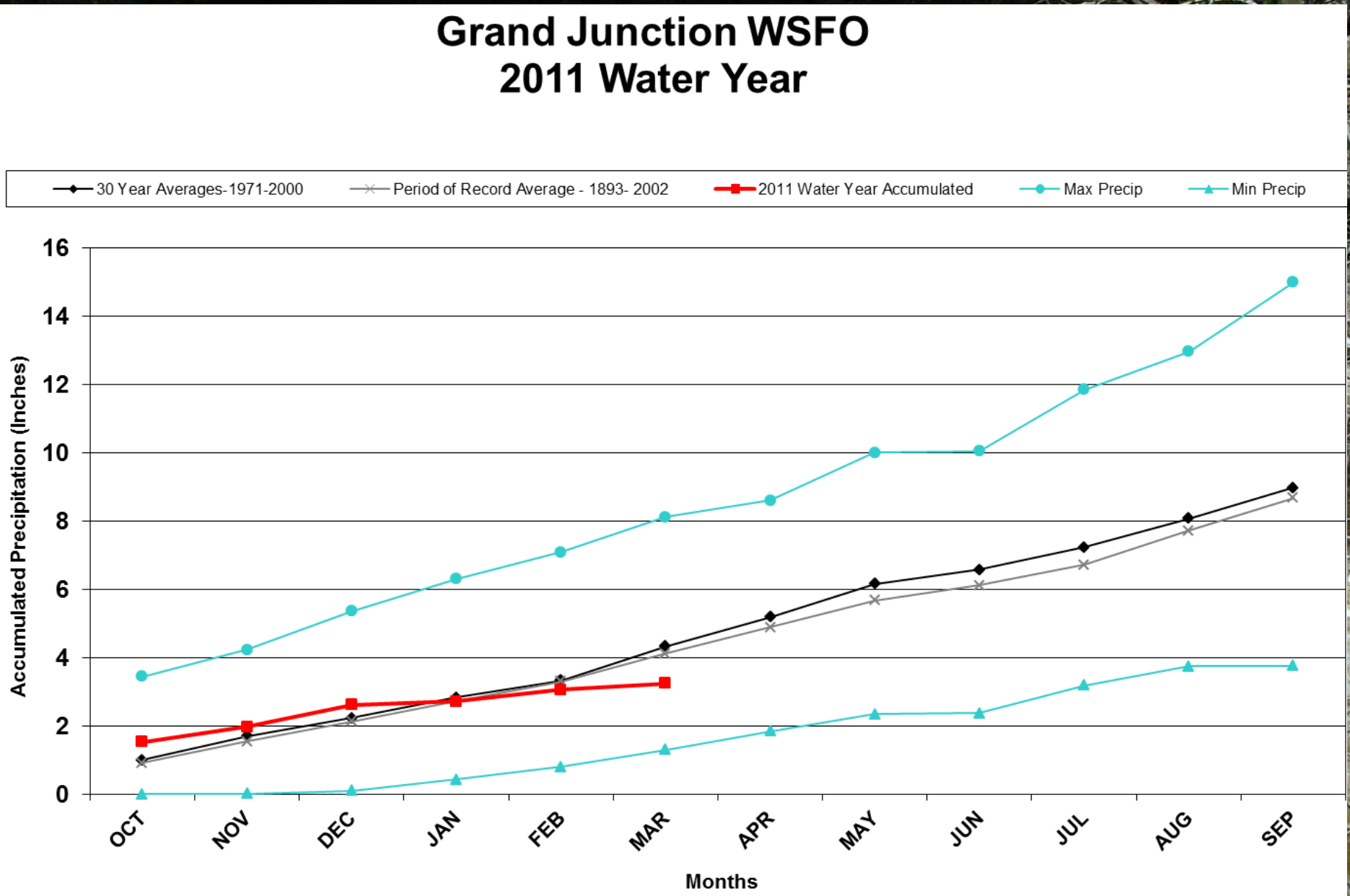
Climate divisions defined by Dr. Klaus Wolter of NOAA's Climate Diagnostic Center in Boulder, CO



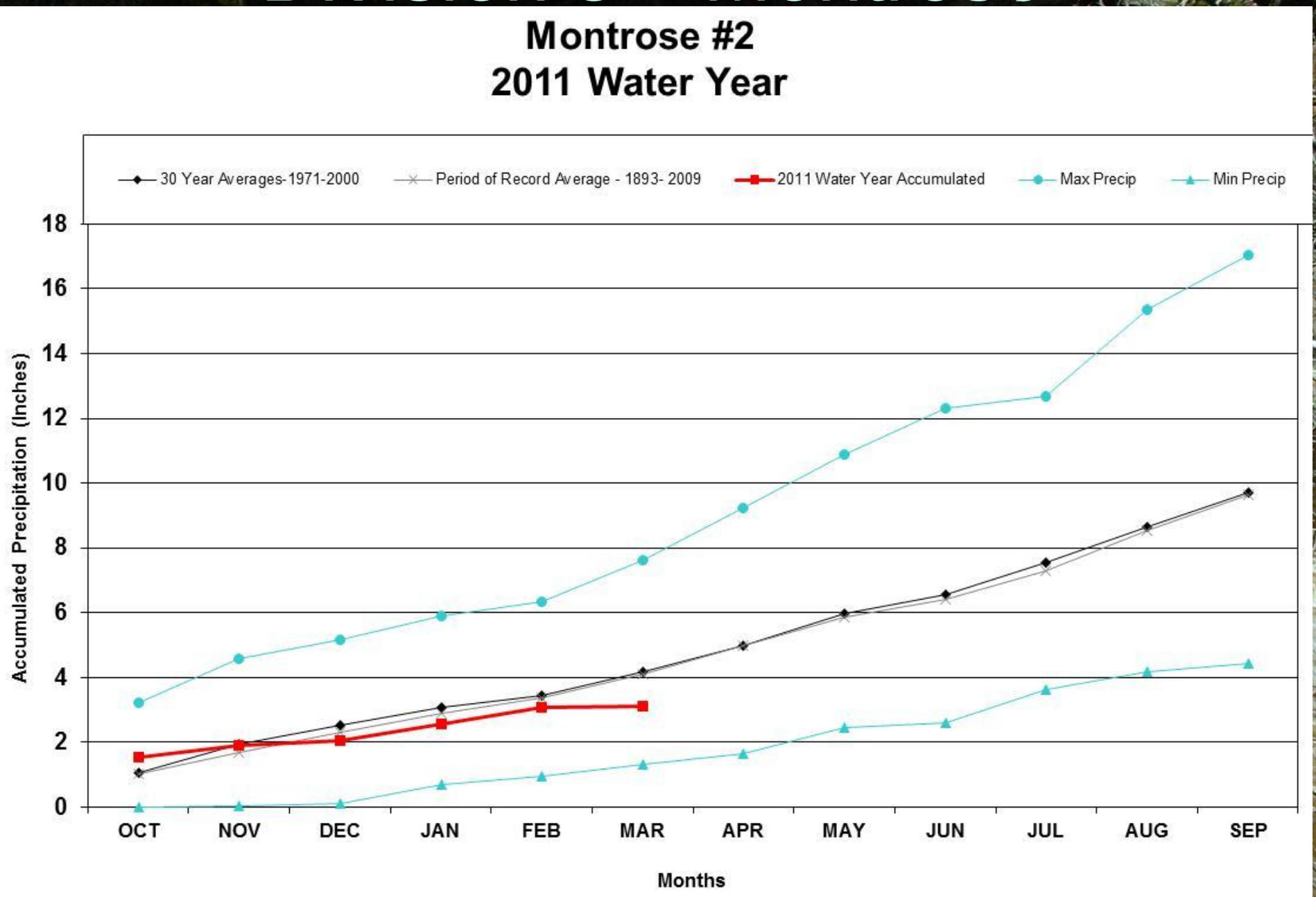
Division 1 – Grand Lake 1NW



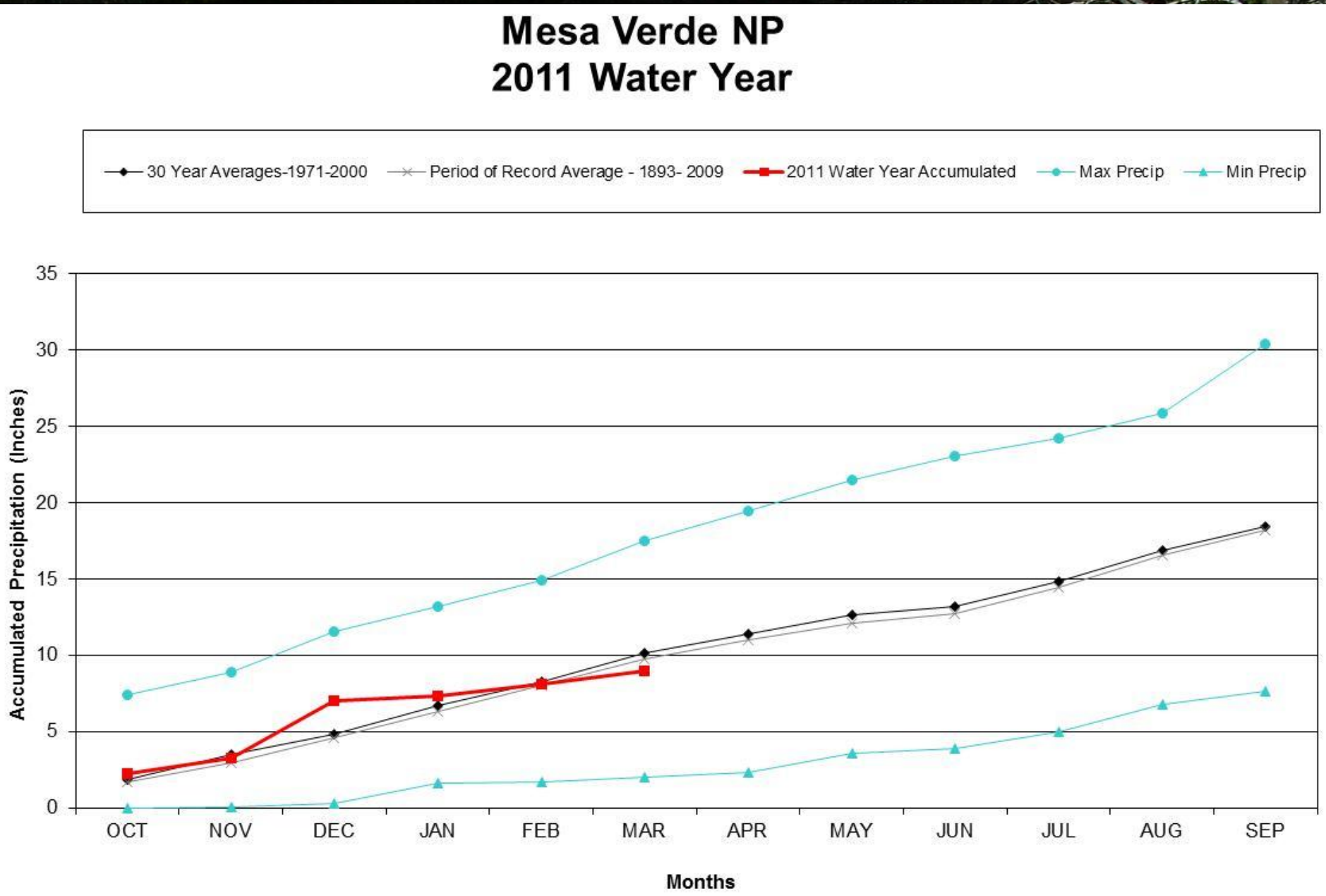
Division 2 – Grand Junction



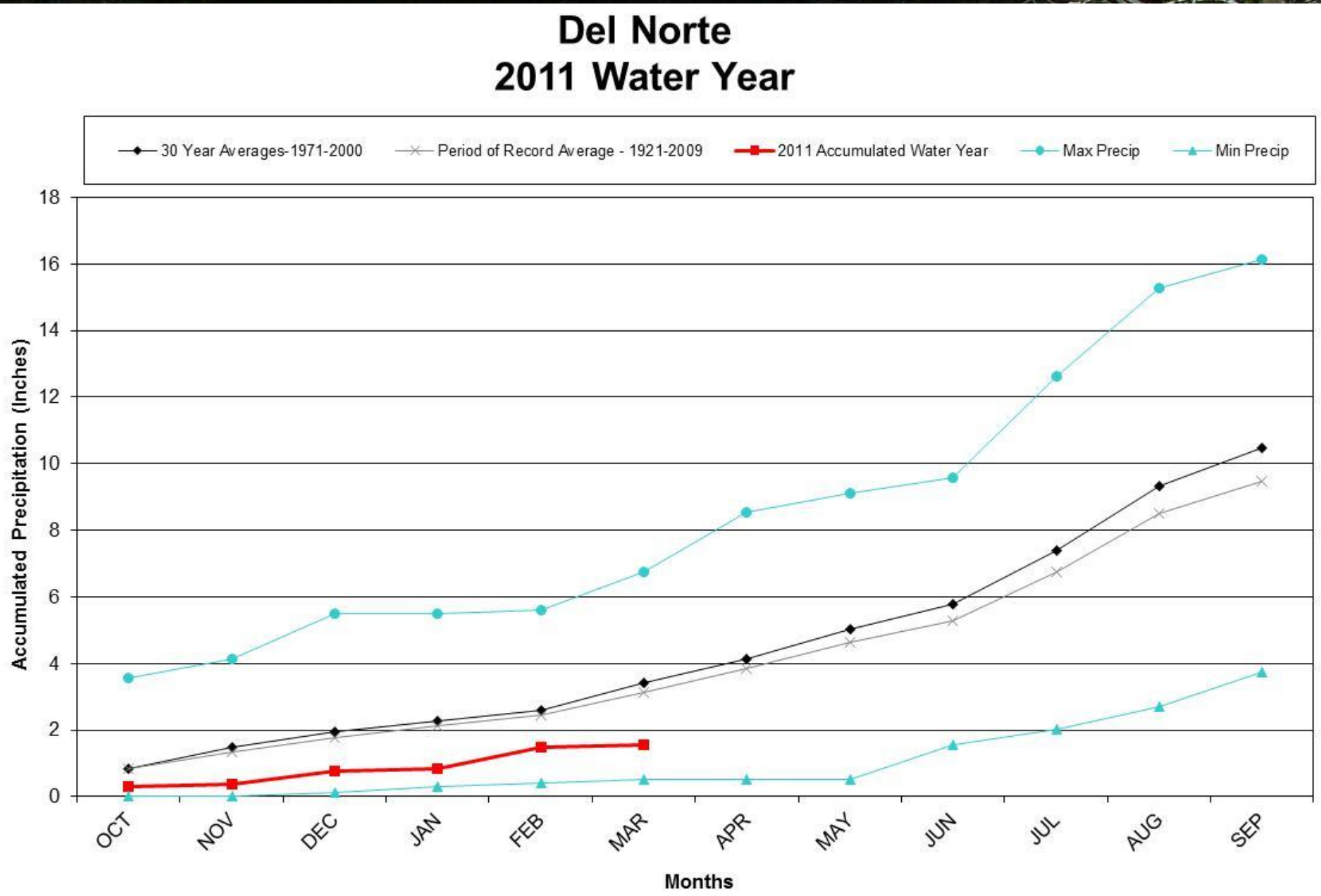
Division 3 – Montrose



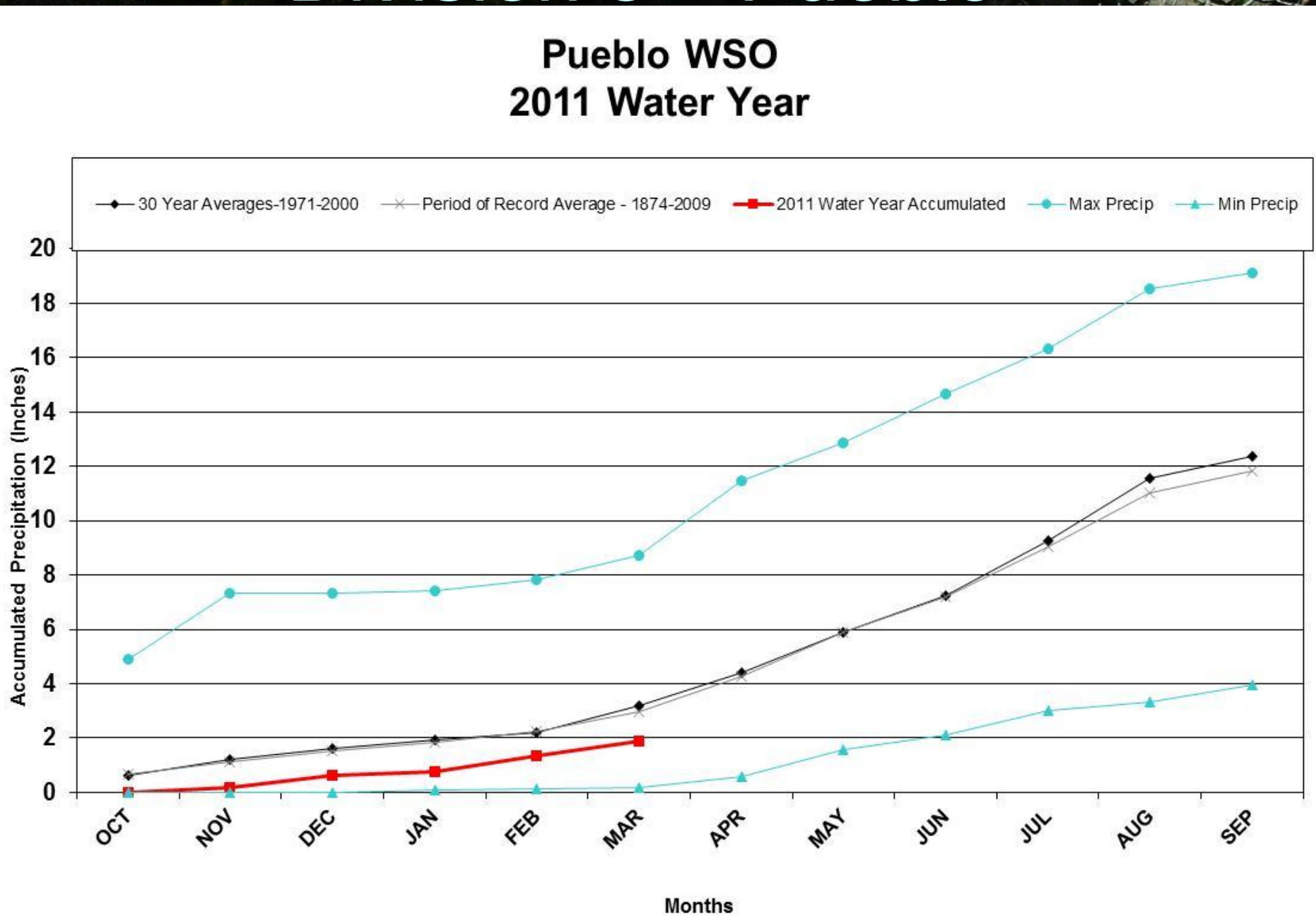
Division 3 – Mesa Verde NP



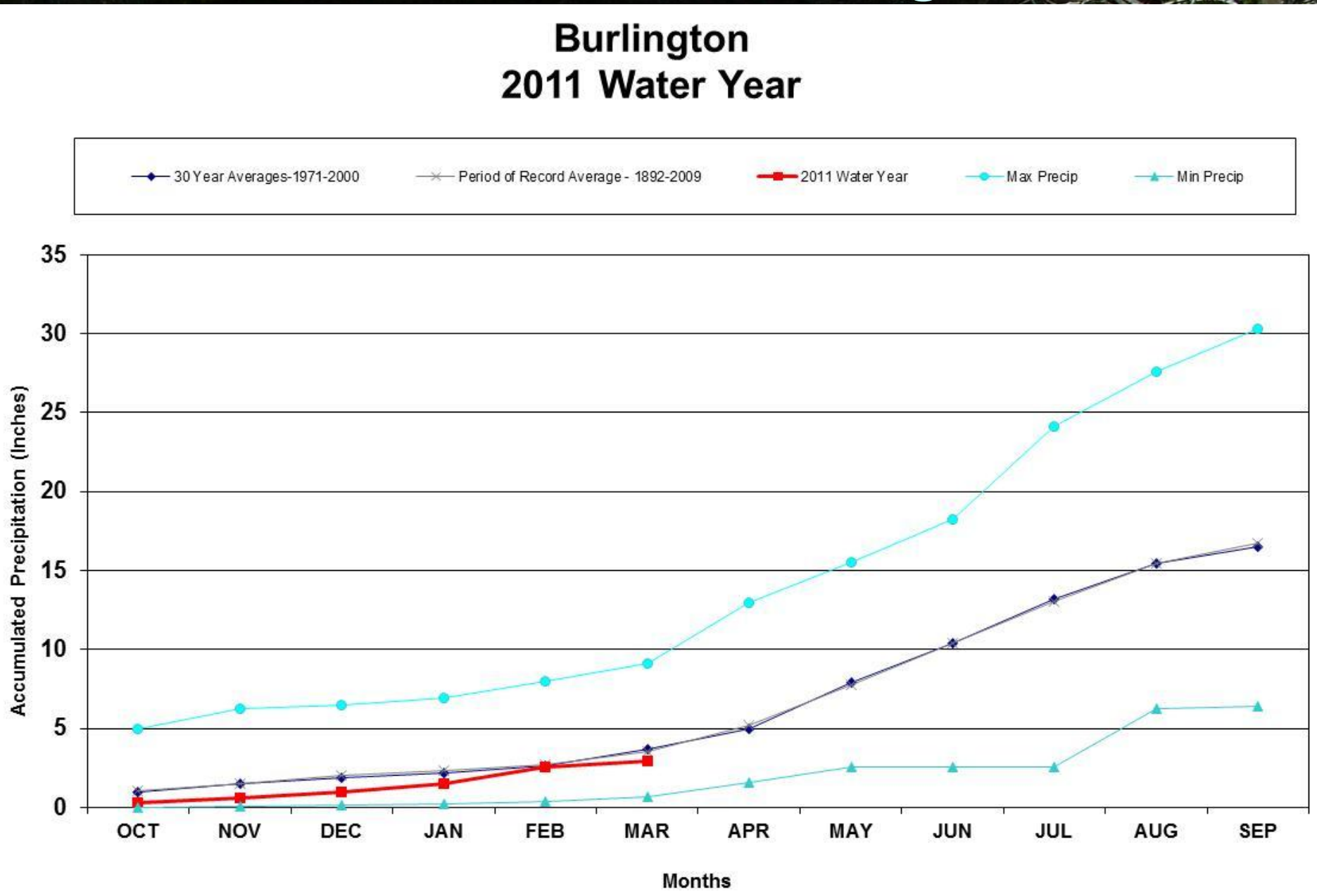
Division 4 – Del Norte



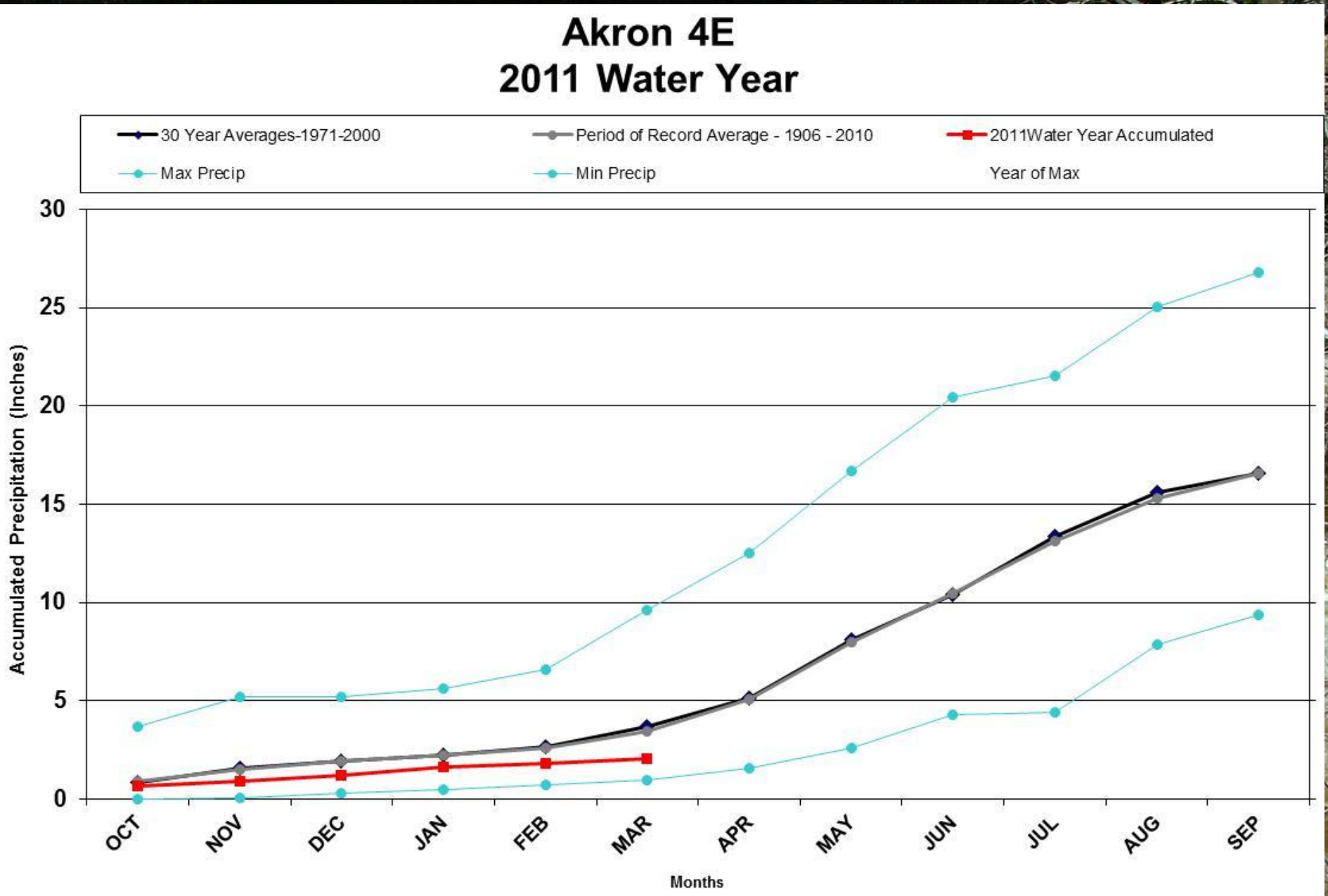
Division 5 – Pueblo



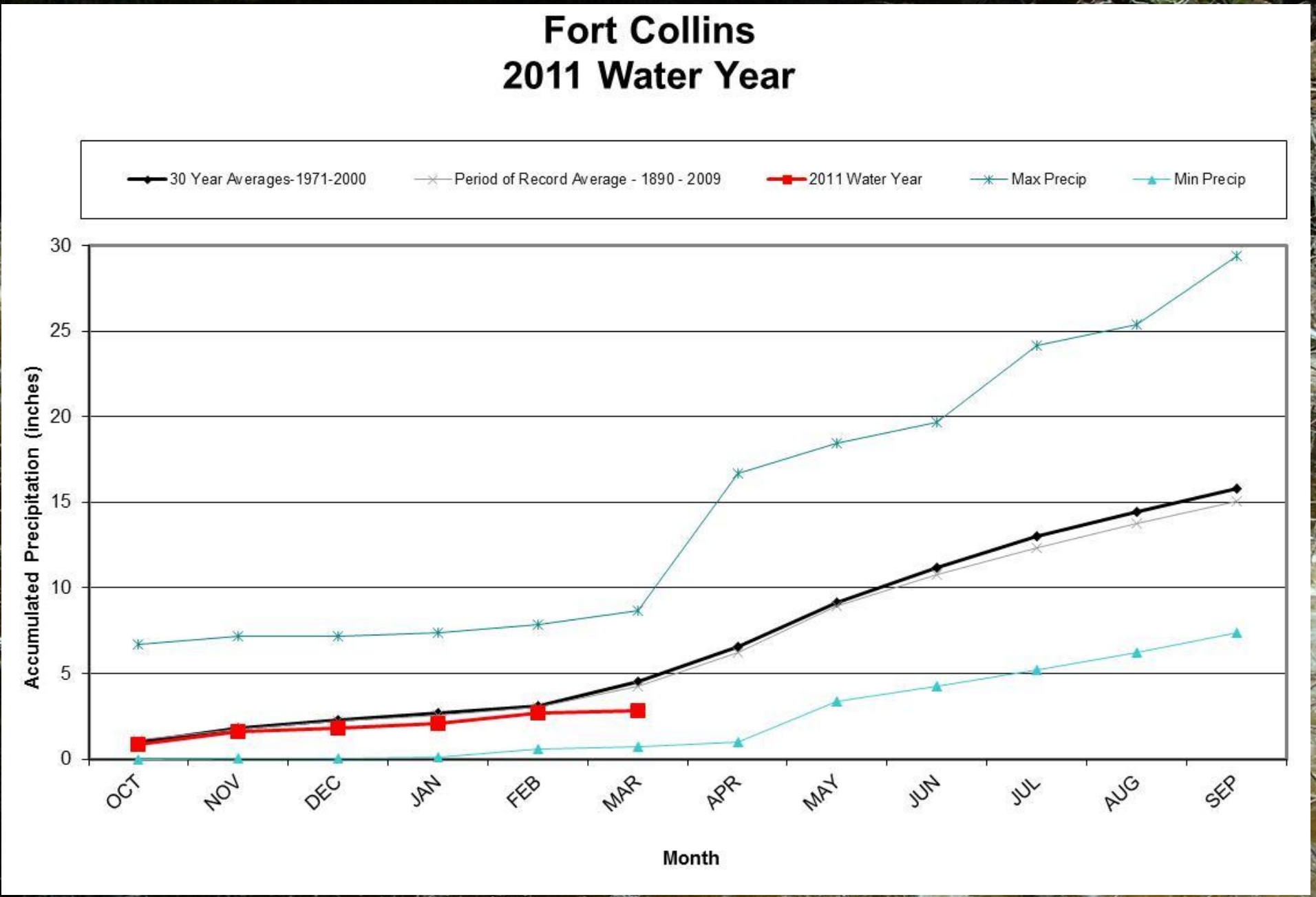
Division 6 - Burlington



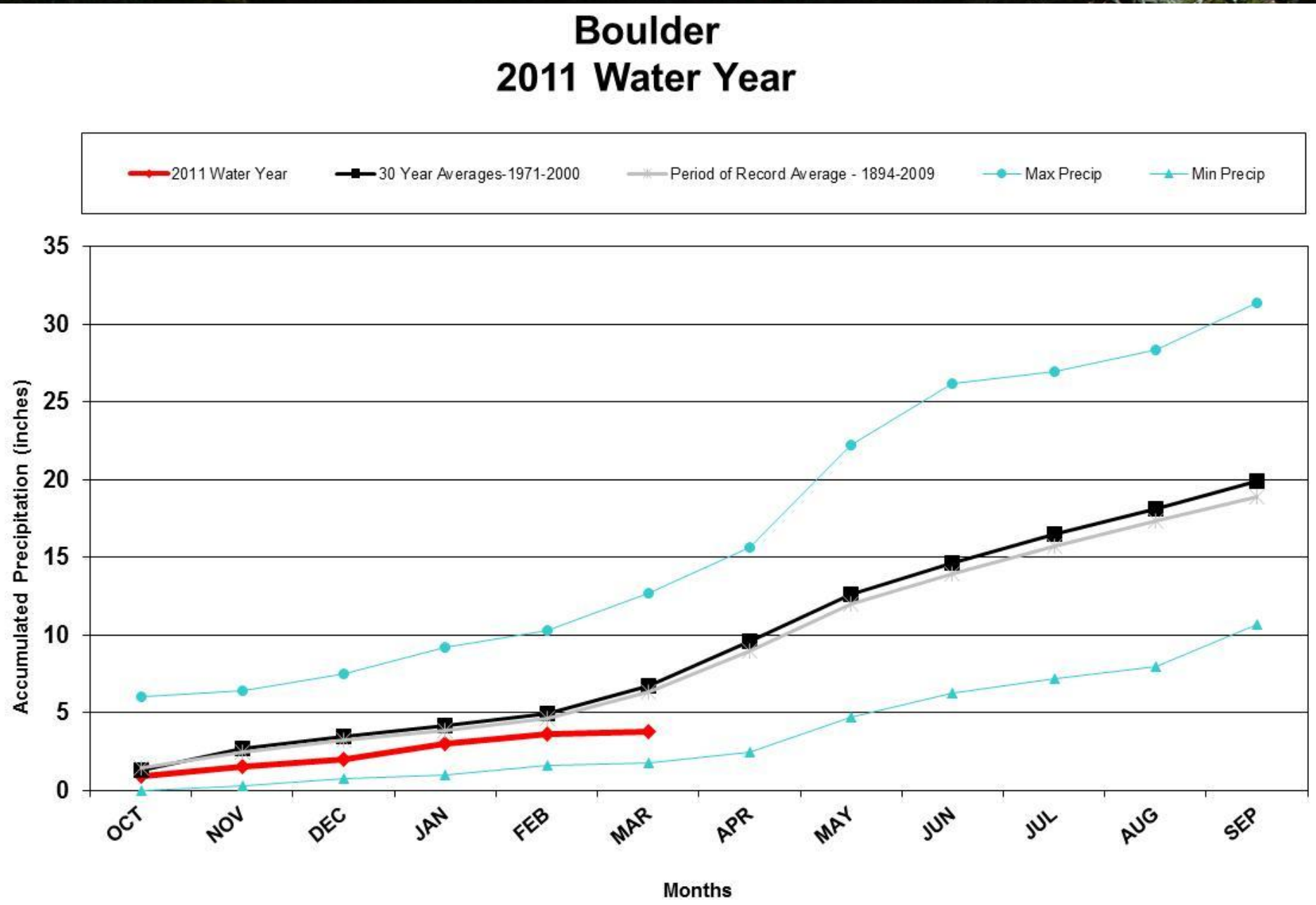
Division 7 – Akron



Division 8 – Fort Collins



Division 8 - Boulder



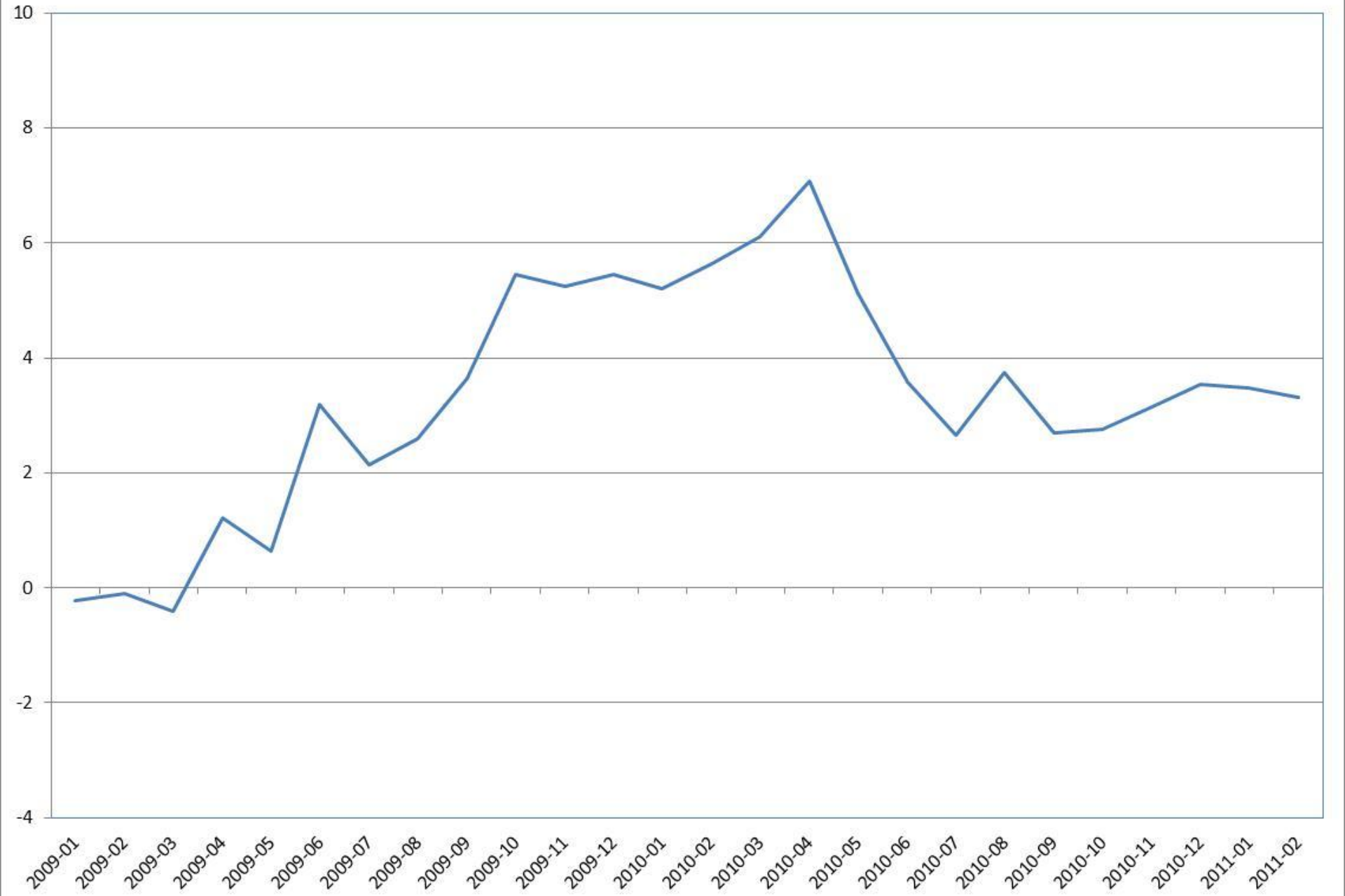
Accumulated Precipitation Departures

- **Used data from 1/2009 – 2/2011**
- **Calculated monthly precipitation departures**
- **Accumulated those departures over the 2 year period.**
  - **A negative slope is an indication of extended below normal precipitation.**
  - **A positive slope is an indication of extended above normal precipitation.**

Walsh 1W Accumulated Precipitation Departure (in) (1/2009-2/2011)

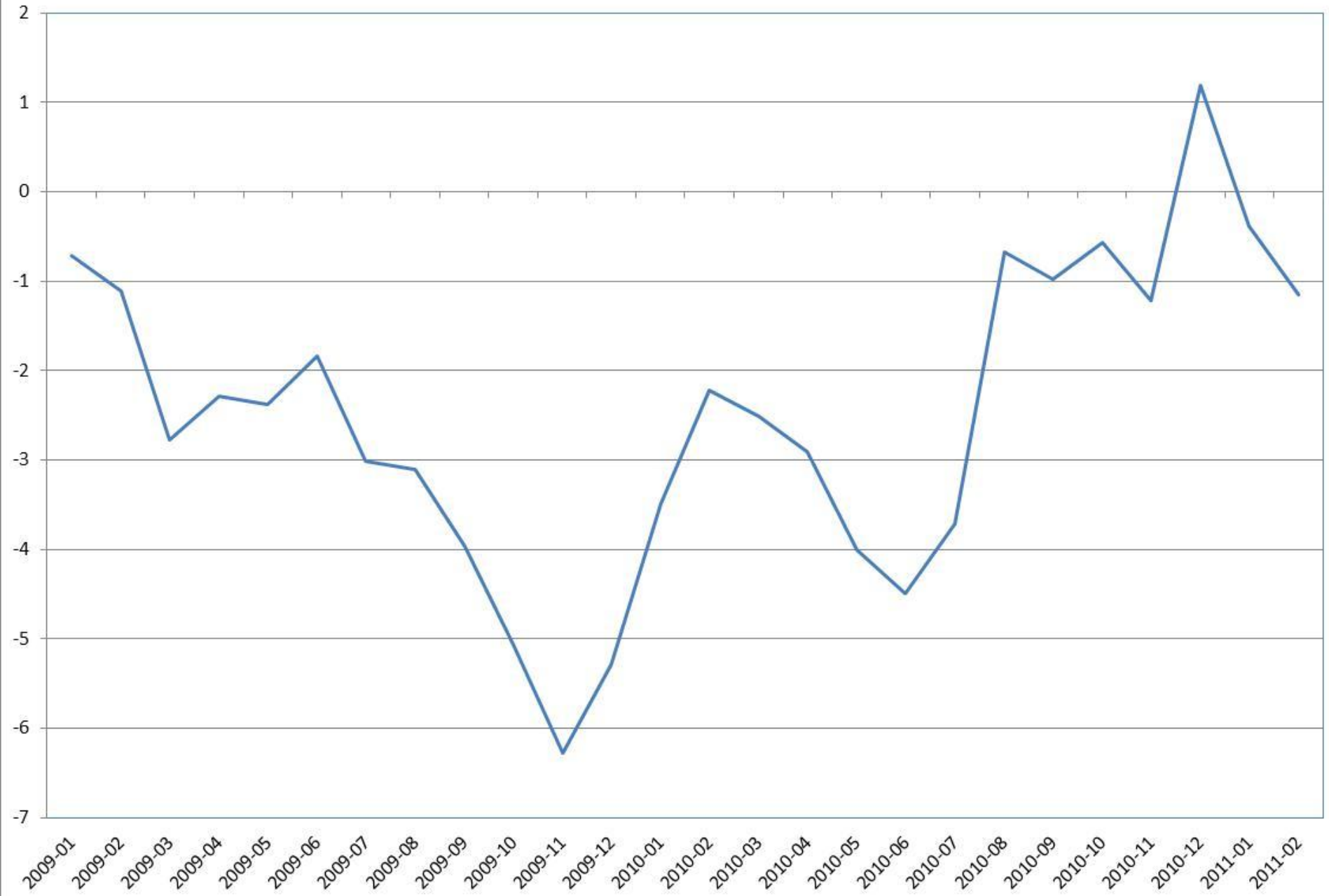
Boulder Accumulated Precipitation Departure (in) (1/2009-2/2011)

Leroy 9WSW Accumulated Precipitation Departure (in) (1/2009-2/2011)



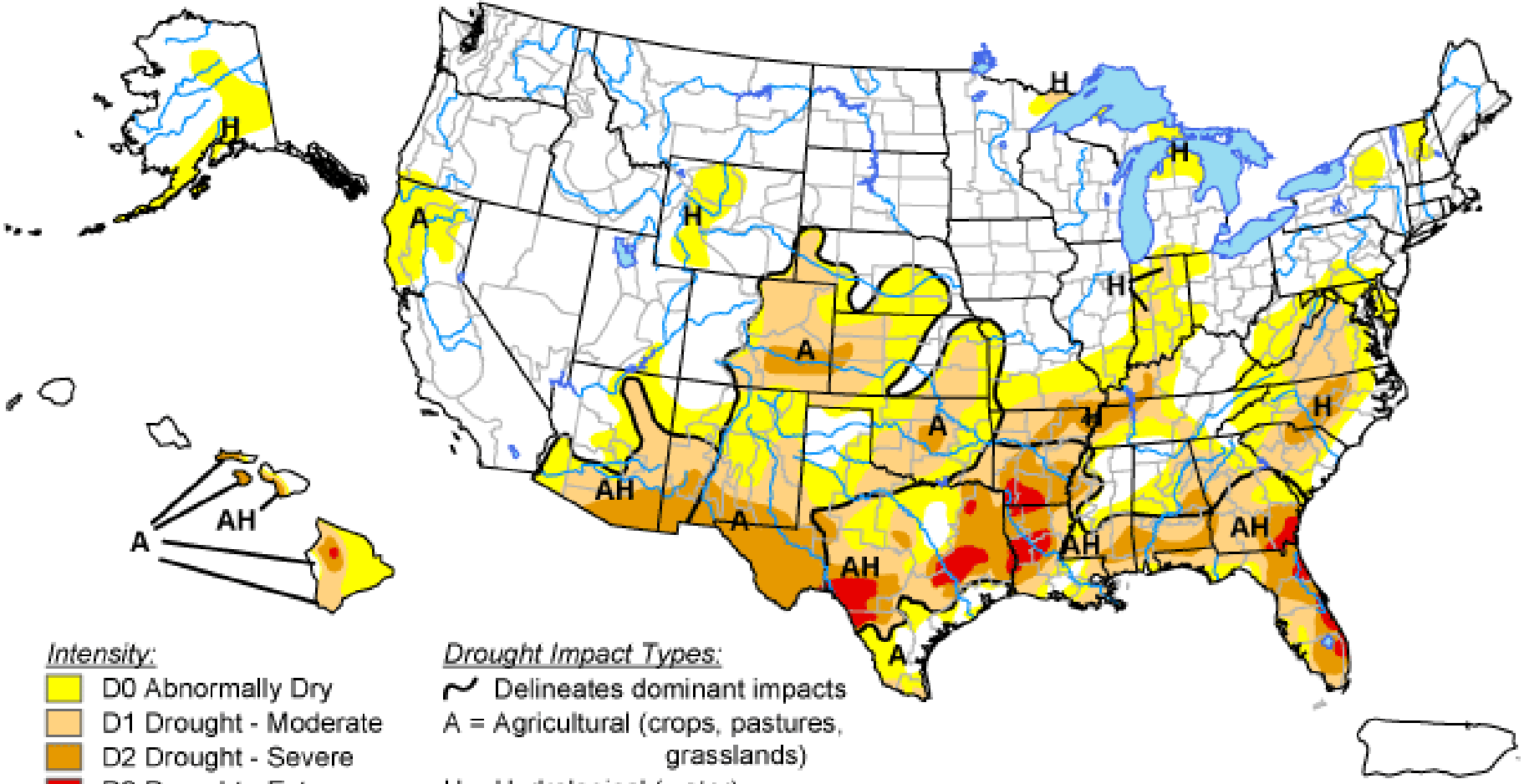
La Junta Accumulated Precipitation Departure (in) (1/2009-2/2011)

Mesa Verde Accumulated Precipitation Departure (in) (1/2009-2/2011)



U.S. Drought Monitor

February 8, 2011
Valid 7 a.m. EST



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.

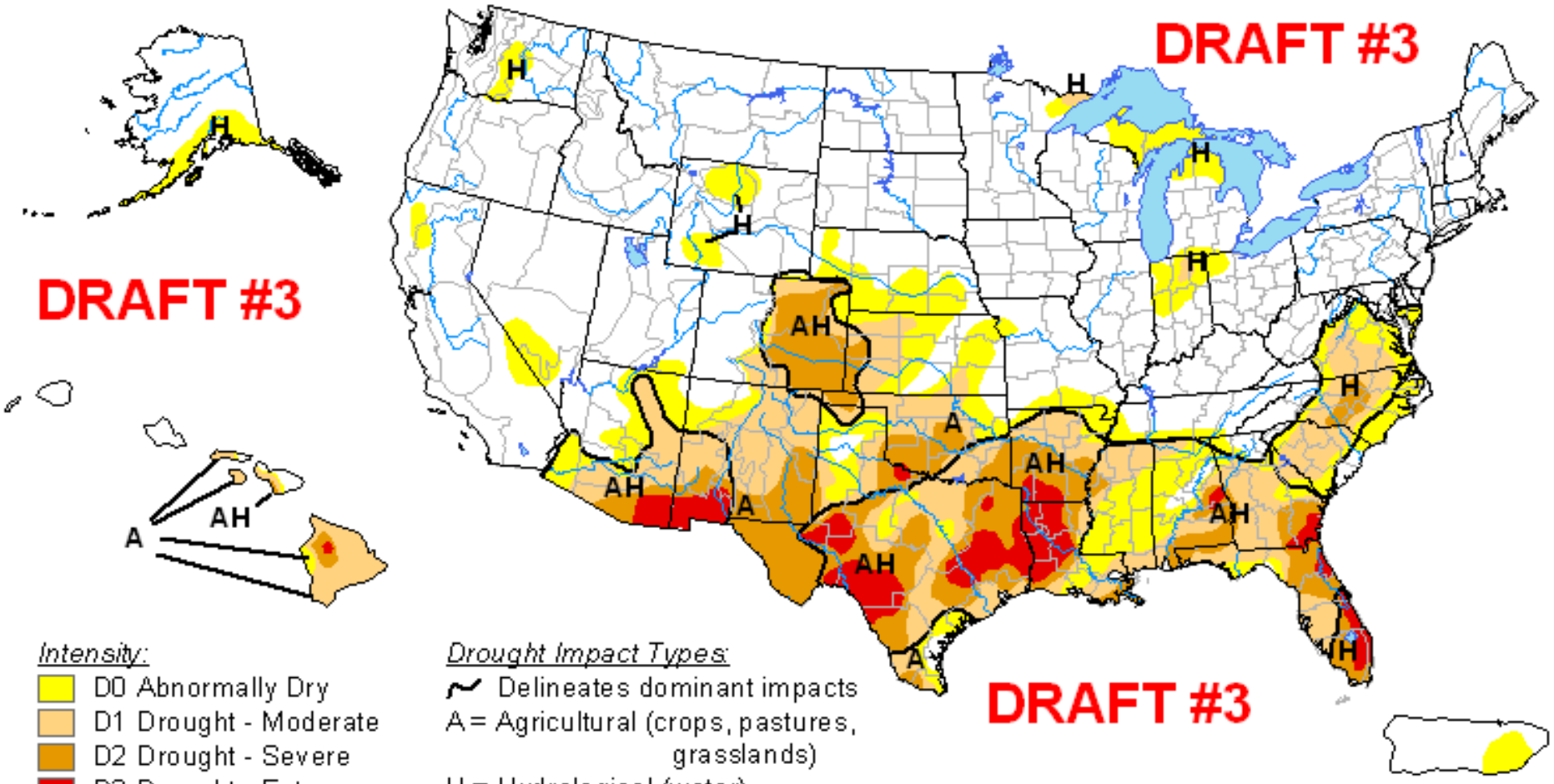
http://drought.unl.edu/dm

Released Thursday, February 10, 2011

Author: Matthew Rosencrans, NOAA/NWS/NCEP/CPC

U.S. Drought Monitor

March 15, 2011
Valid 8 a.m. EDT



Intensity:
- D0 Abnormally Dry
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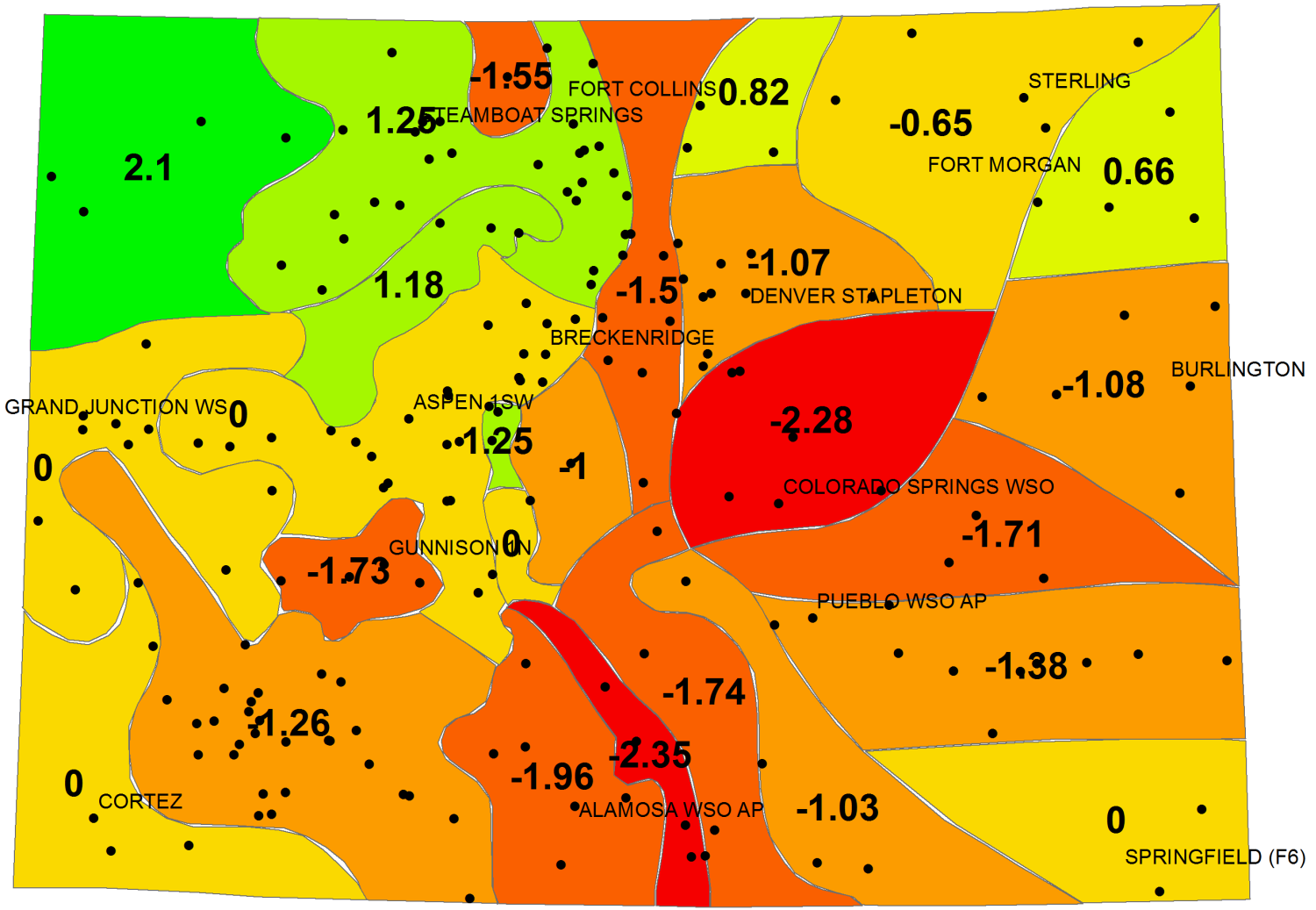
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

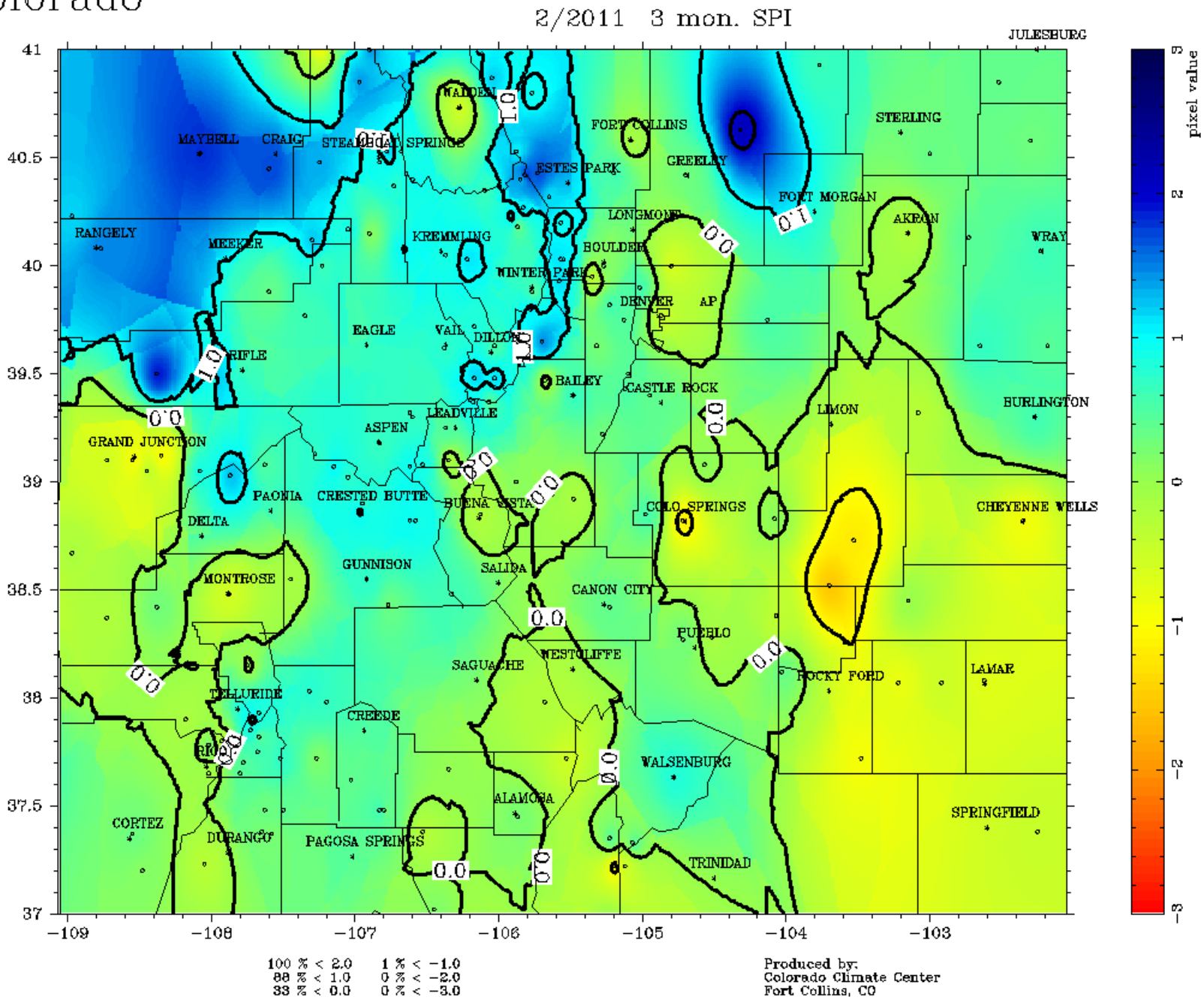
http://drought.unl.edu/dm

Released Thursday, March 17, 2011
Author: Laura Edwards, Western Regional Climate Center

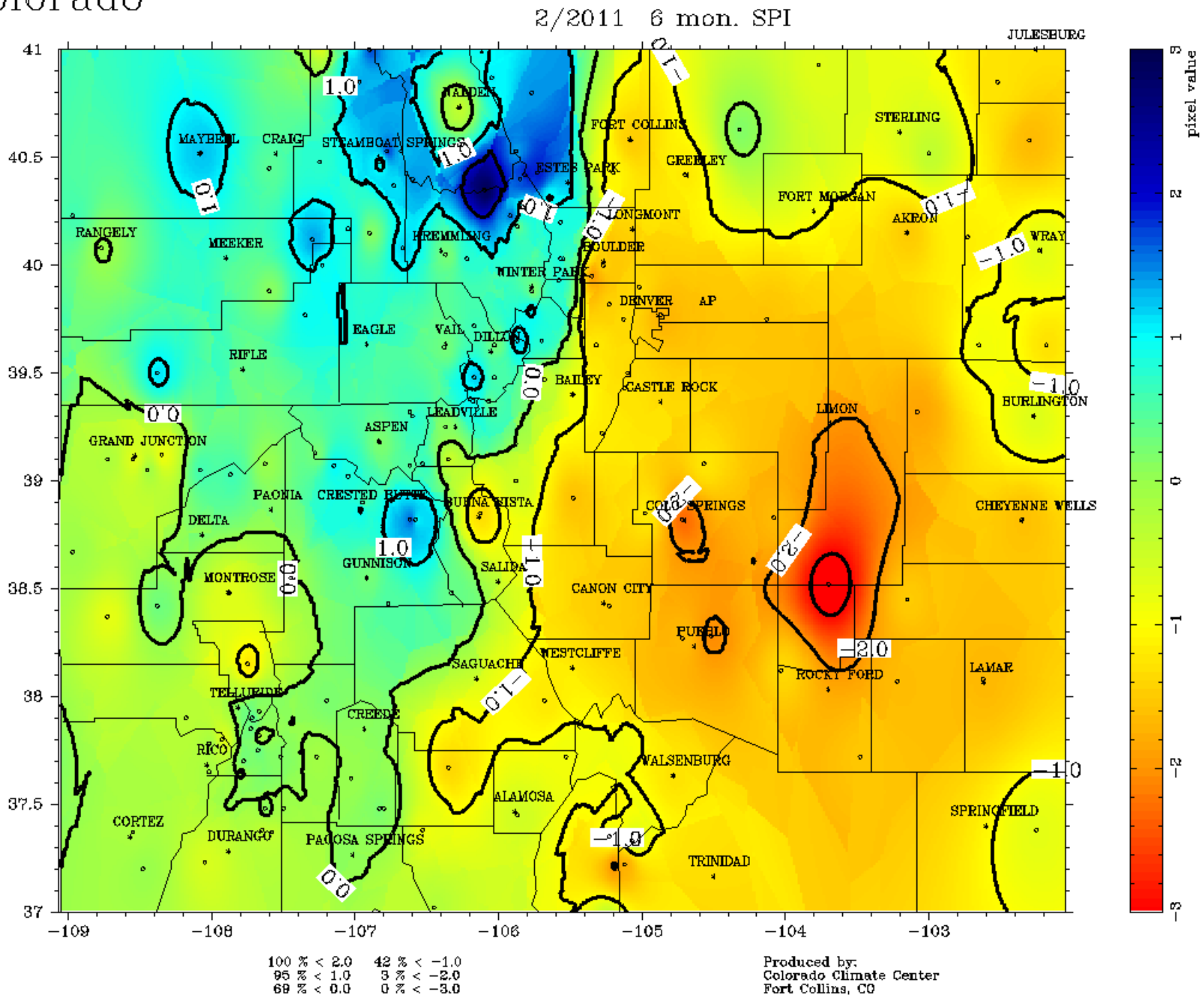
Modified Palmer Drought Severity Index for Colorado
February 2011



Colorado


2/2011 3 mon. SPI
JULESBURG
STERLING
FORT COLLINS
GREELEY
ESTES PARK
FORT MORGAN
LONGMONT
AKRON
WRAY
BOULDER
WINTER PARK
DENVER AP
MAYBELL
CRAIG
STEAMBOAT SPRINGS
MAIDEL
RANGELY
MEEKER
KREMMLING
EAGLE
VAIL
DILLON
RIFLE
BAILEY
CASTLE ROCK
LIMON
BURLINGTON
LEADVILLE
ASPEN
GRAND JUNCTION
PAONIA
CRESTED BUTTE
BUENA VISTA
COLO SPRINGS
CHEYENNE WELLS
DELTA
GUNNISON
SALIDA
MONTROSE
CANON CITY
PUEBLO
SAGUACHE
WESTCLIFFE
ROCKY FORD
LAMAR
TELLURIDE
CREEDE
WALSENBURG
ALAMOSA
SPRINGFIELD
CORTEZ
DURANGO
PAGOSA SPRINGS
TRINIDAD
41
40.5
40
39.5
39
38.5
38
37.5
37
−109
−108
−107
−106
−105
−104
−103
pixel value
3
2
1
0
−1
−2
−3
100 % < 2.0
88 % < 1.0
33 % < 0.0
1 % < −1.0
0 % < −2.0
0 % < −3.0
Produced by:
Colorado Climate Center
Fort Collins, CO

Colorado


2/2011 6 mon. SPI
JULESBURG
STERLING
FORT COLLINS
GREELEY
FORT MORGAN
AKRON
WRAY
LONGMONT
BOULDER
ESTES PARK
STEAMBOAT SPRINGS
CRAIG
MAYBELL
HAYDEN
RANGELY
MEEKER
PREMONT
WINTER PARK
DENVER AP
EAGLE
VAIL
DILLON
RIFLE
BAILEY
CASTLE ROCK
LIMON
BURLINGTON
GRAND JUNCTION
ASPEN
LEADVILLE
PAONIA
CRESTED BUTTE
BUENA VISTA
COLO SPRINGS
CHEYENNE WELLS
DELTA
GUNNISON
SALIDA
MONTROSE
CANON CITY
PUEBLO
WESTCLIFFE
SAGUACHE
ROCKY FORD
LAMAR
TELLURIDE
CREEDE
RICO
WALSENBURG
ALAMOSA
SPRINGFIELD
CORTEZ
DURANGO
PAGOSA SPRINGS
TRINIDAD
pixel value
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95 % < 1.0
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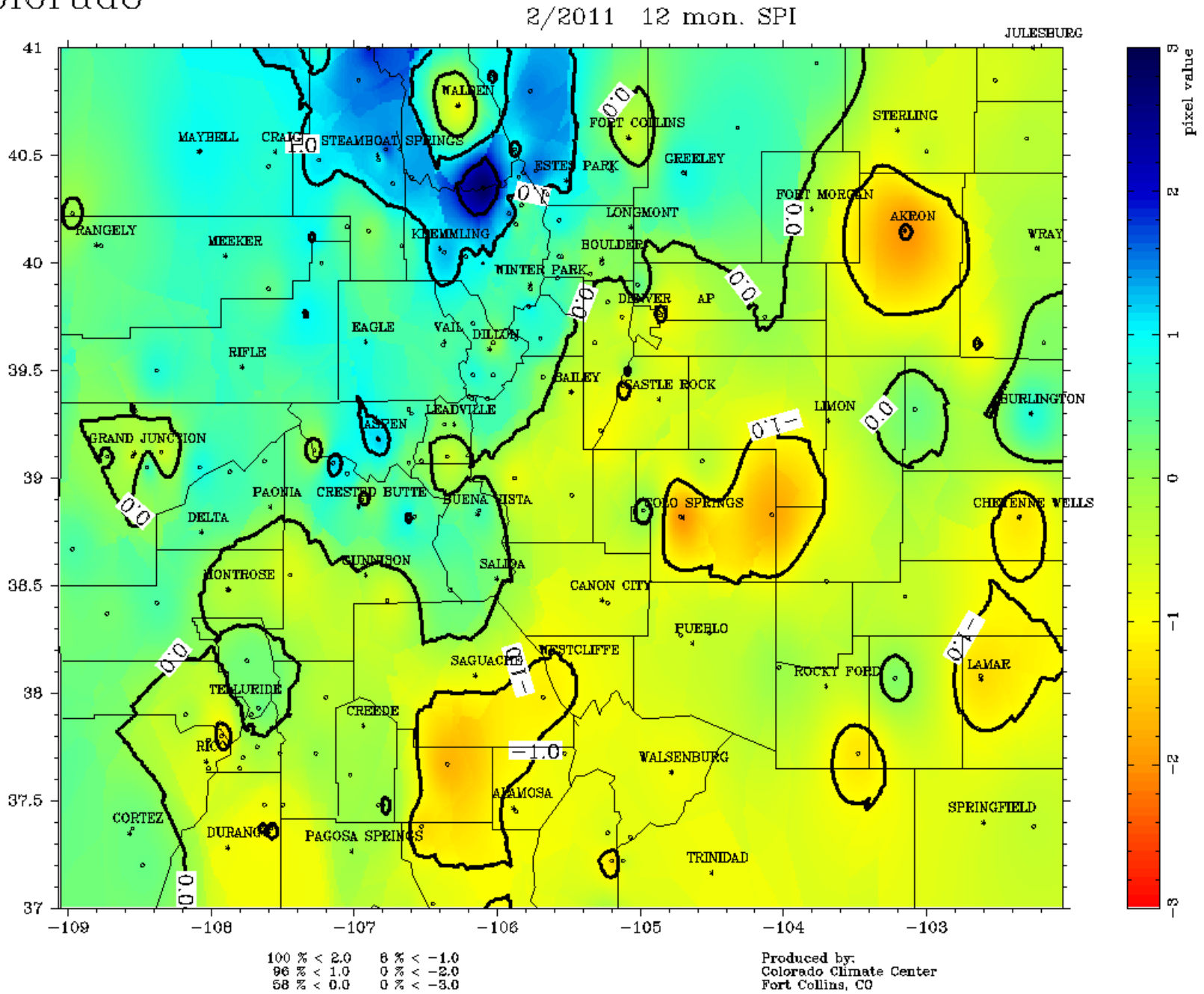
0 % < -3.0
Produced by:
Colorado Climate Center
Fort Collins, CO

Colorado


2/2011 12 mon. SPI
JULESBURG
STERLING
WALDEN
FORT COLLINS
MAYBELL
CRAIG
STEAMBOAT SPRINGS
ESTES PARK
GREELEY
FORT MORGAN
AKRON
LONGMONT
RANGELY
MEEKER
KREMMLING
BOULDER
WRAY
WINTER PARK
DENVER AP
EAGLE
VAIL
DILLON
RIFLE
BAILEY
CASTLE ROCK
LIMON
BURLINGTON
ASPEN
LEADVILLE
GRAND JUNCTION
PAONIA
CRESTED BUTTE
BUENA VISTA
COLO SPRINGS
CHEYENNE WELLS
DELTA
GUNNISON
SALIDA
MONTROSE
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WESTCLIFFE
SAGUACHE
ROCKY FORD
LAMAR
TELLURIDE
CREEDE
RICO
WALSENBURG
ALAMOSA
SPRINGFIELD
CORTEZ
DURANGO
PAGOSA SPRINGS
TRINIDAD
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−106
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−104
−103
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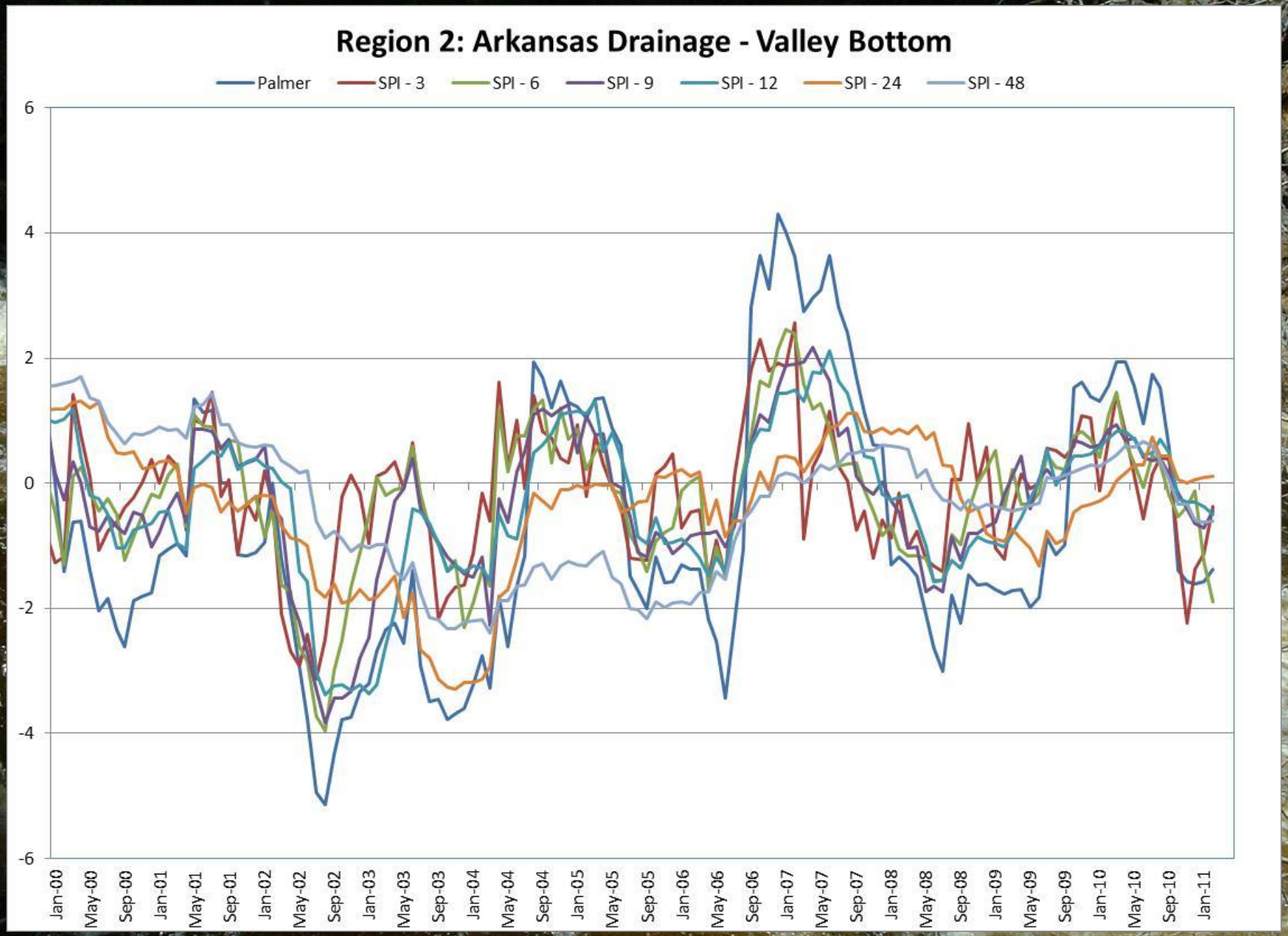
Produced by:
Colorado Climate Center
Fort Collins, CO


Region 2: Arkansas Drainage - Valley Bottom
Palmer
SPI - 3
SPI - 6
SPI - 9
SPI - 12
SPI - 24
SPI - 48
6
4
2
0
-2
-4
-6
Jan-00
May-00
Sep-00
Jan-01
May-01
Sep-01
Jan-02
May-02
Sep-02
Jan-03
May-03
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Jan-04
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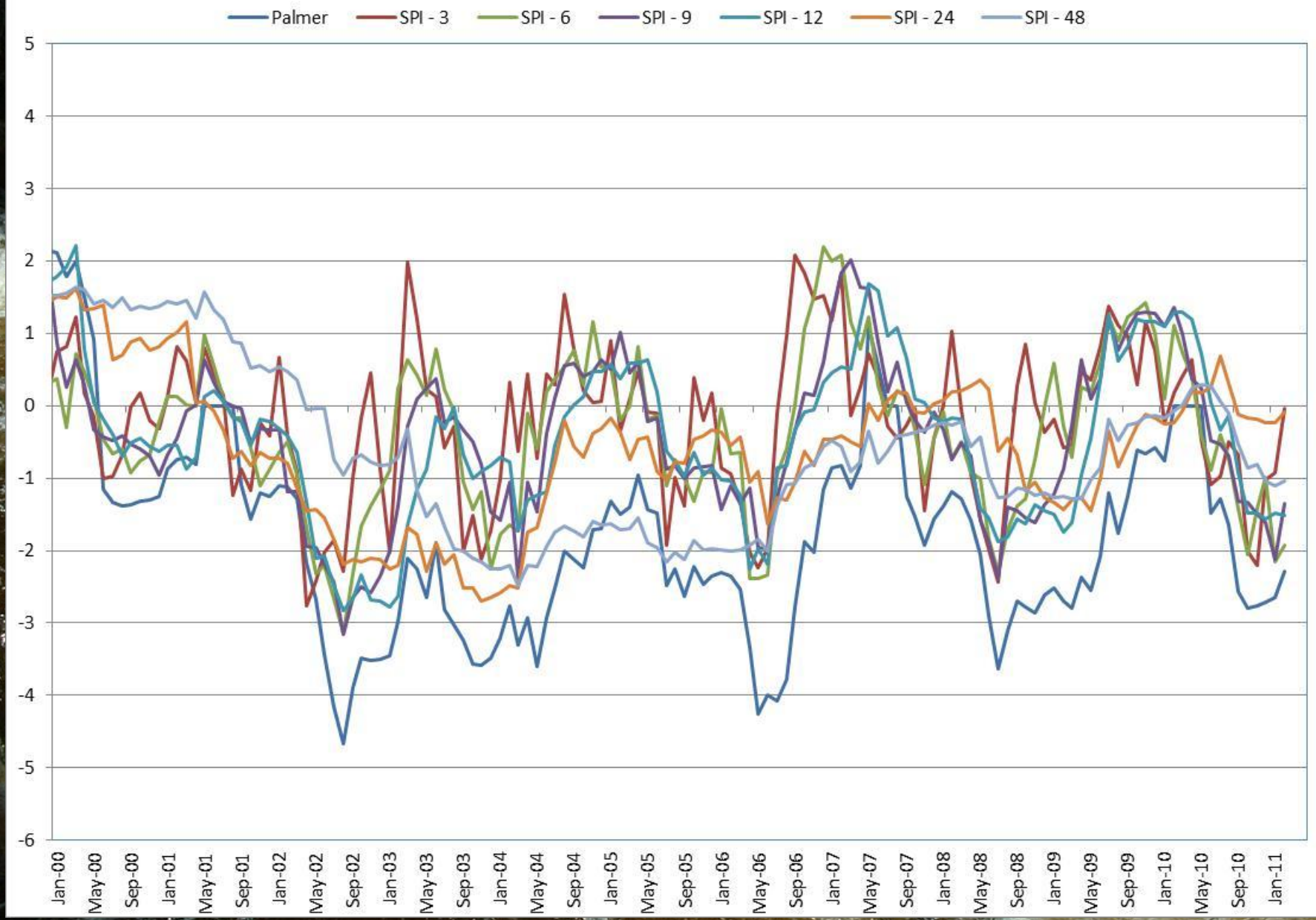
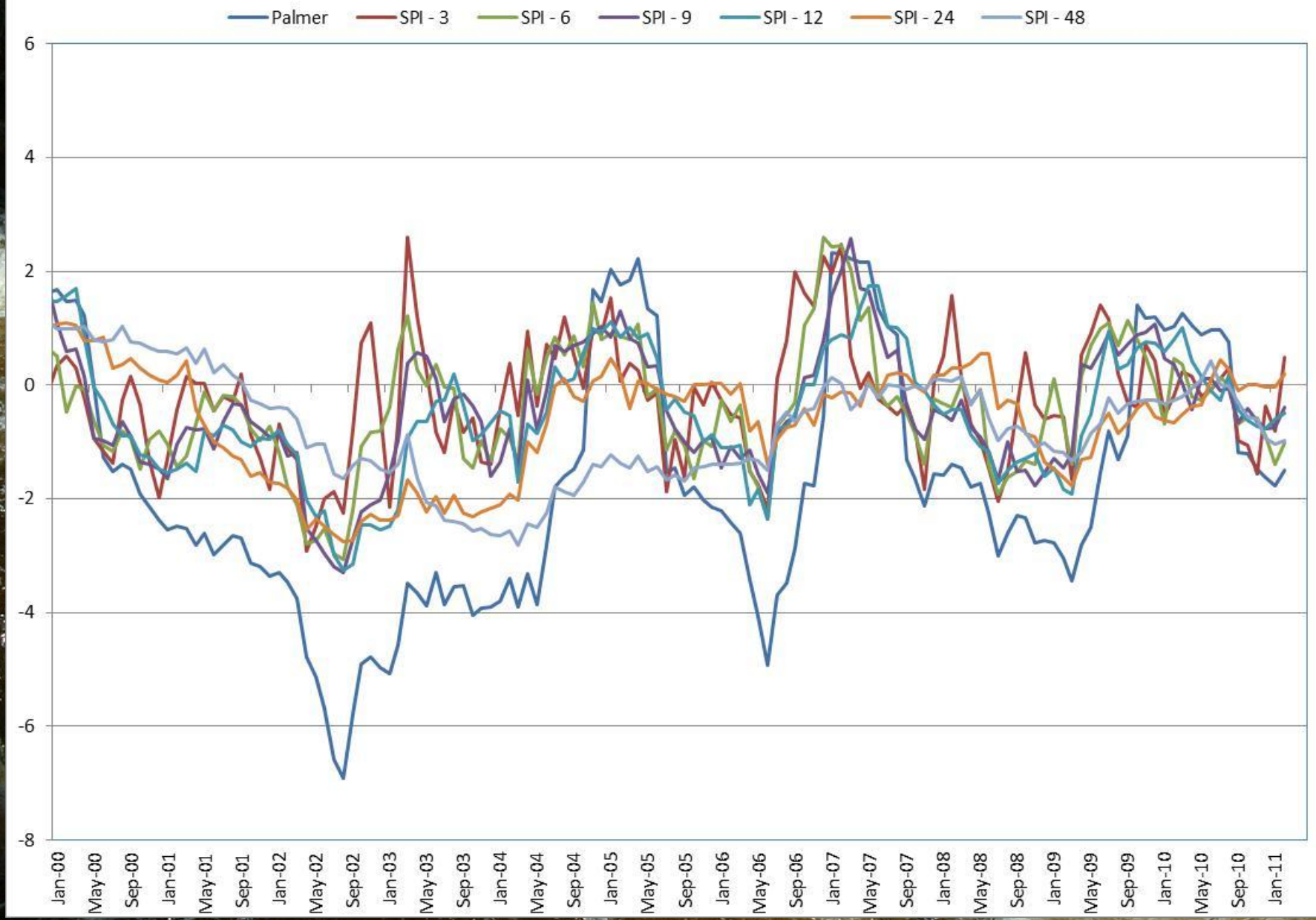
Jan-10
May-10
Sep-10
Jan-11

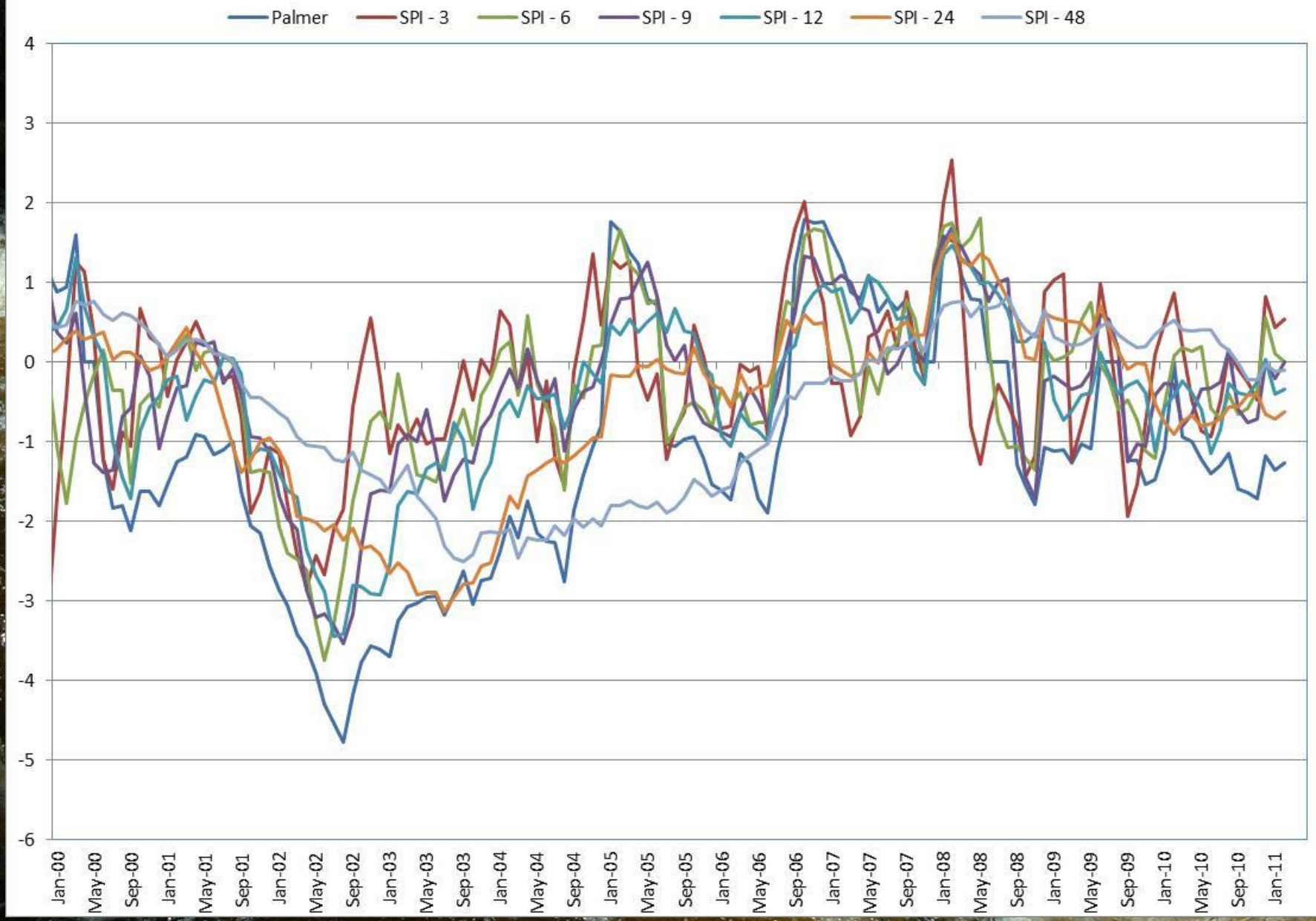
Region 13: Pikes Peak



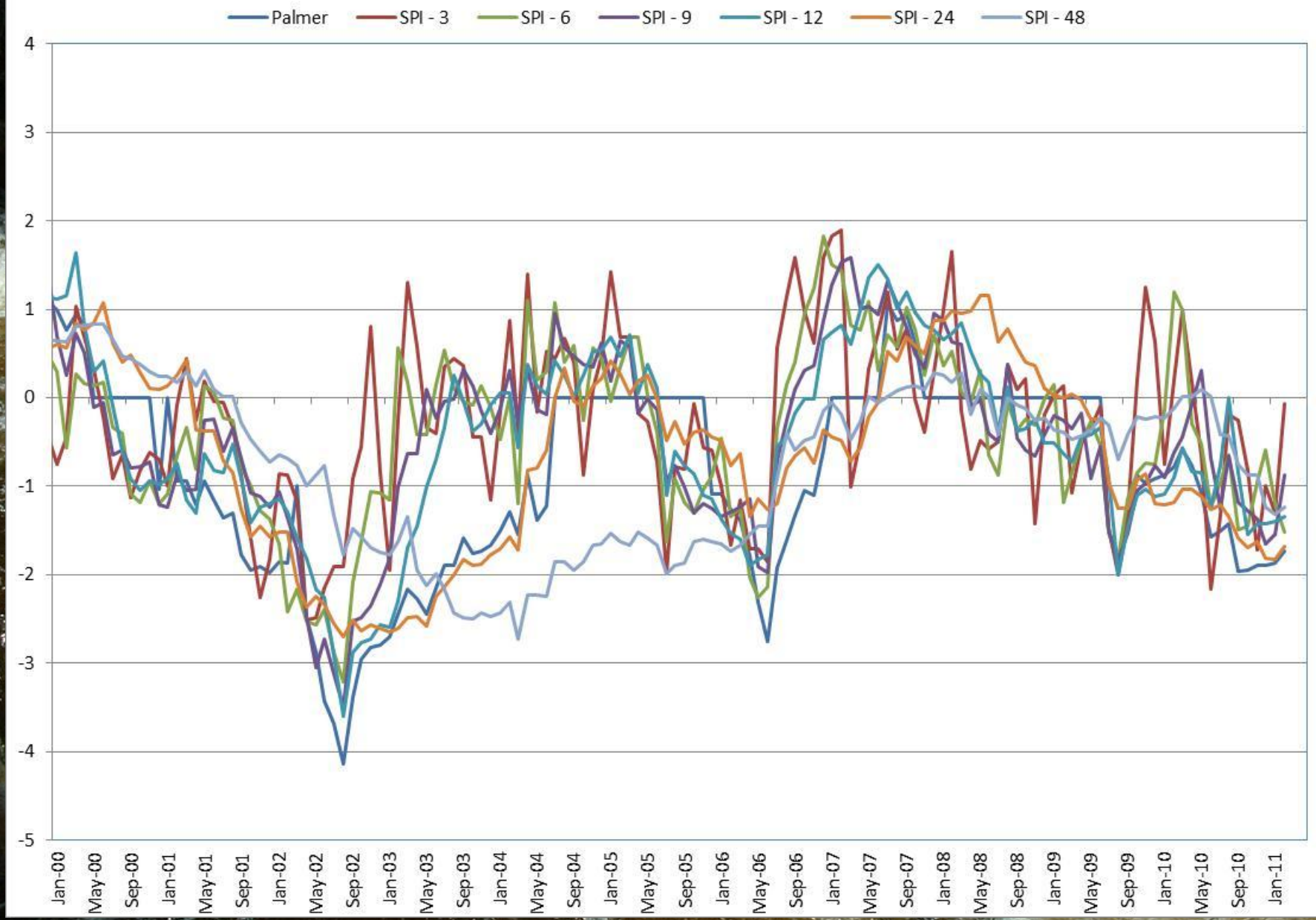
Region 14: Front Range



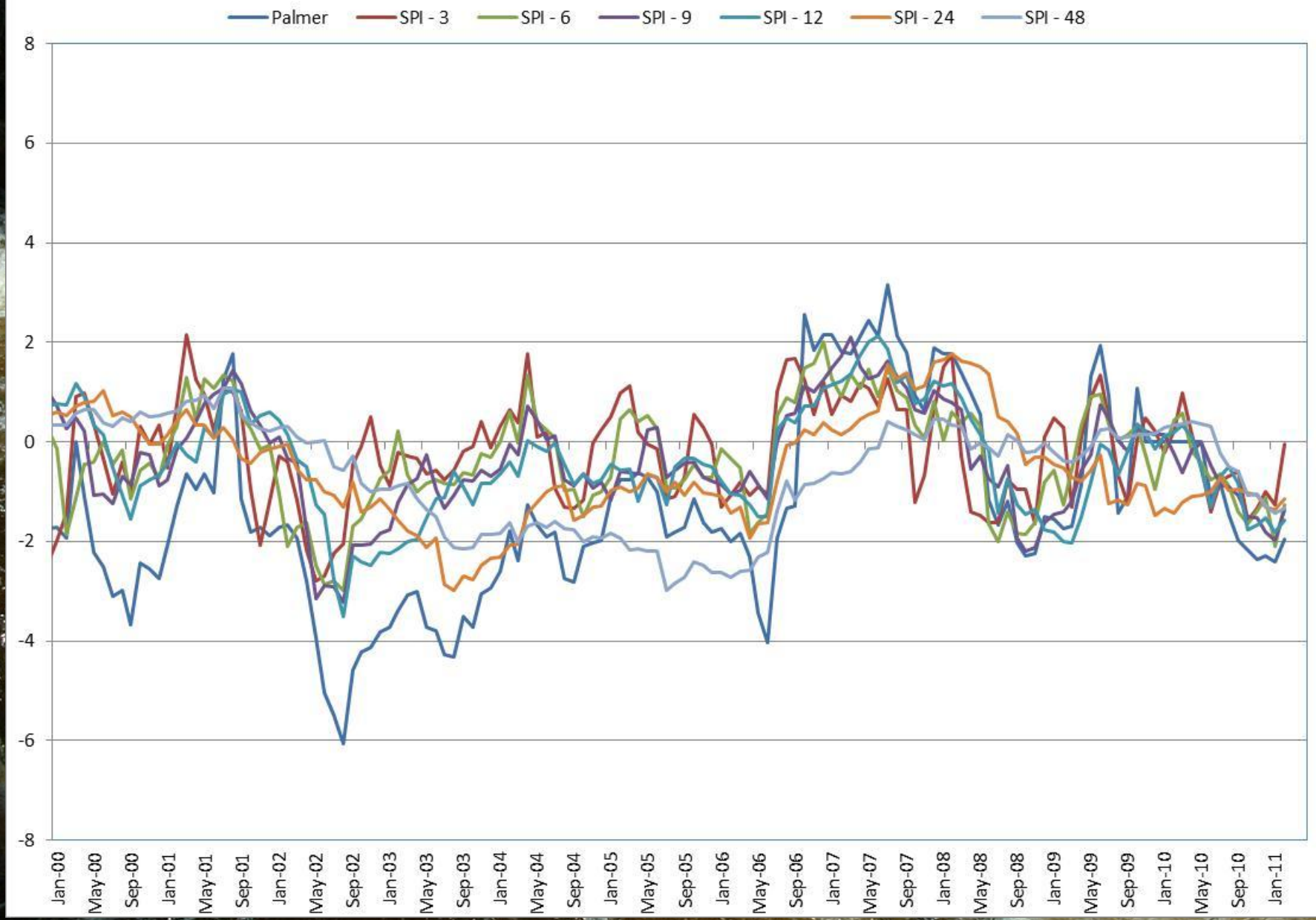
Region 23: San Juans



Region 5: Arkansas Drainage : Foothills



Region 17 : San Luis Valley

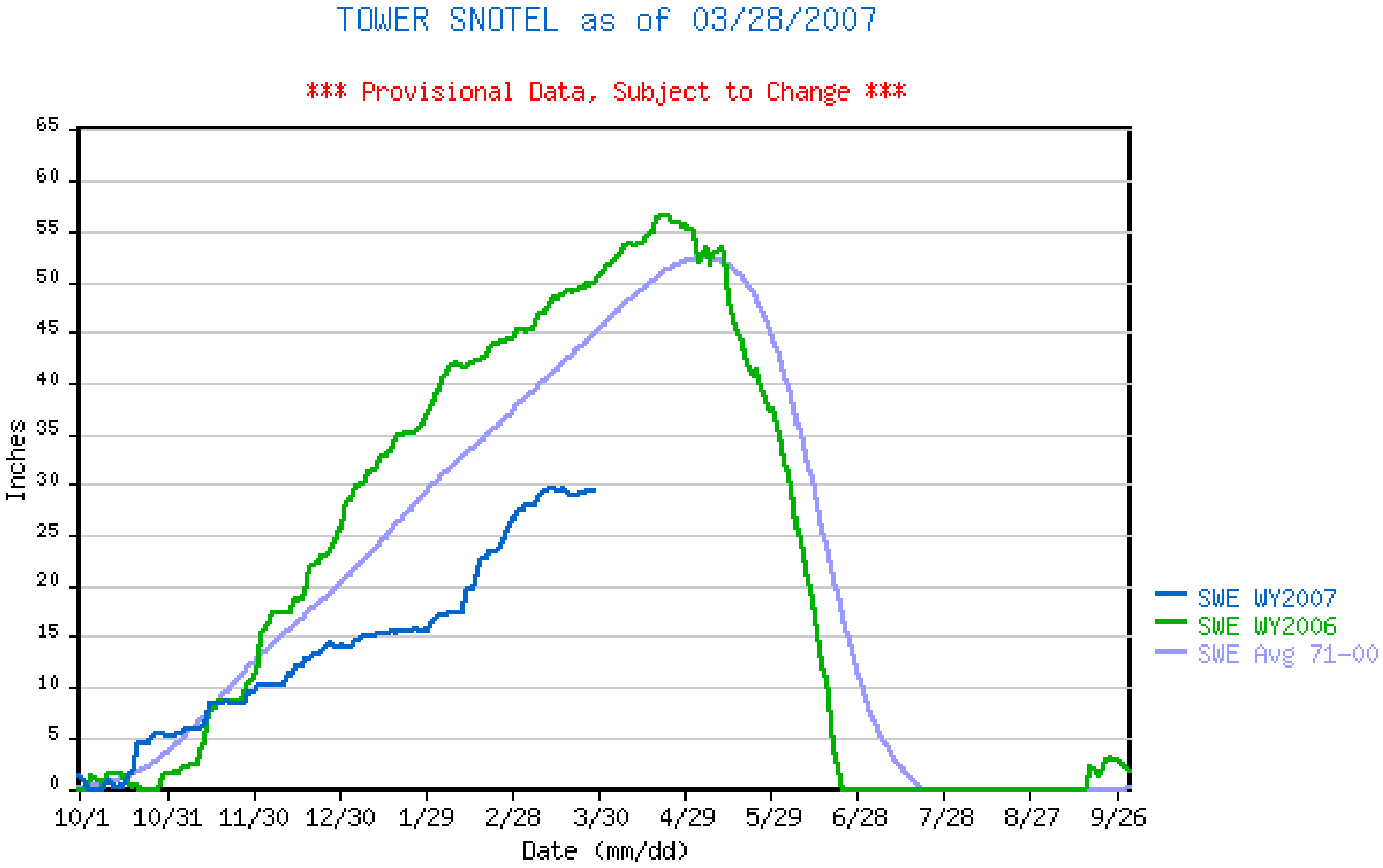


Climatological Perspectives on Flooding in Colorado

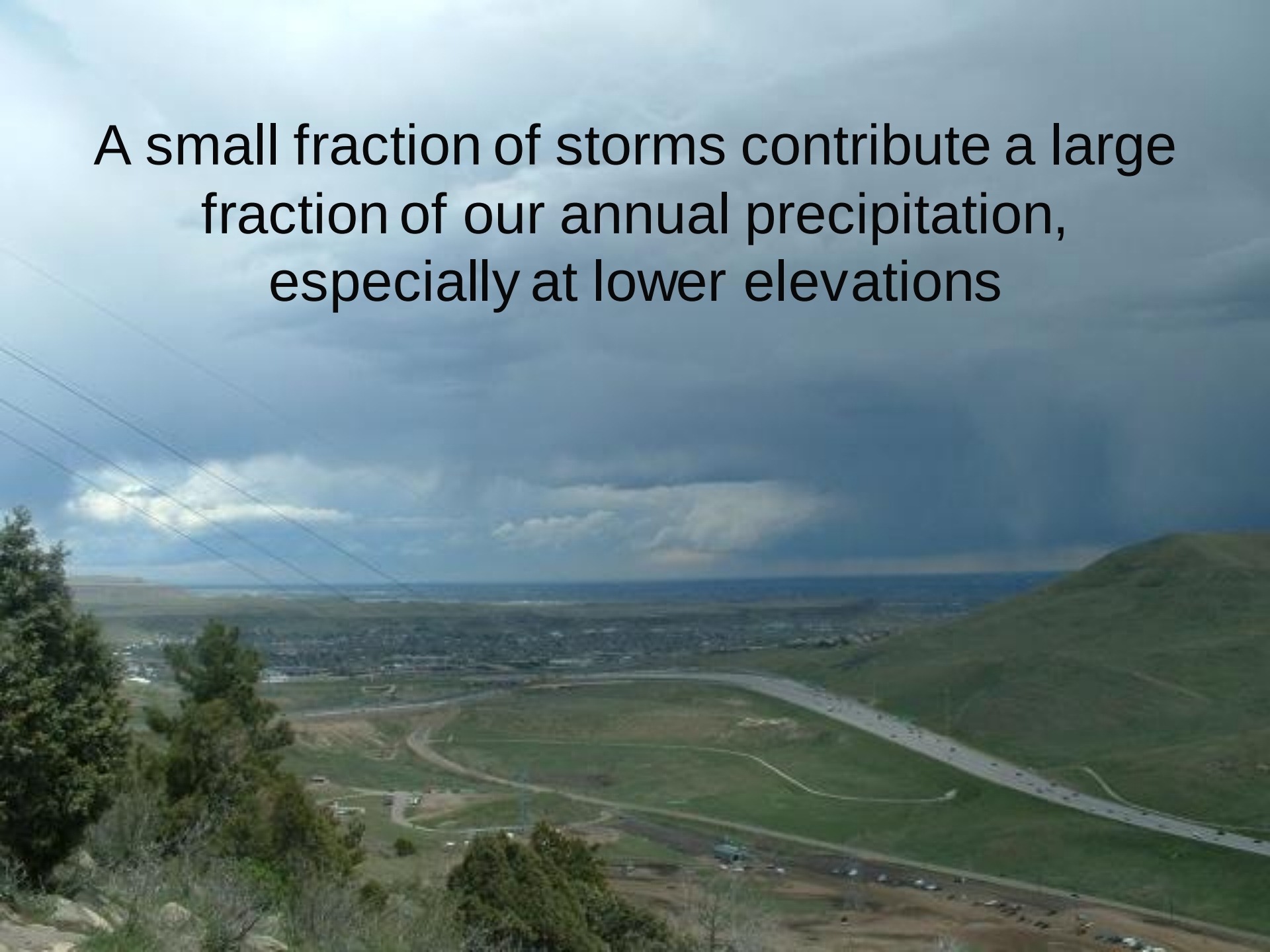
Colorado is also known for periodic and sometimes extreme floods!

Spring Creek Flood, photo by John Weaver

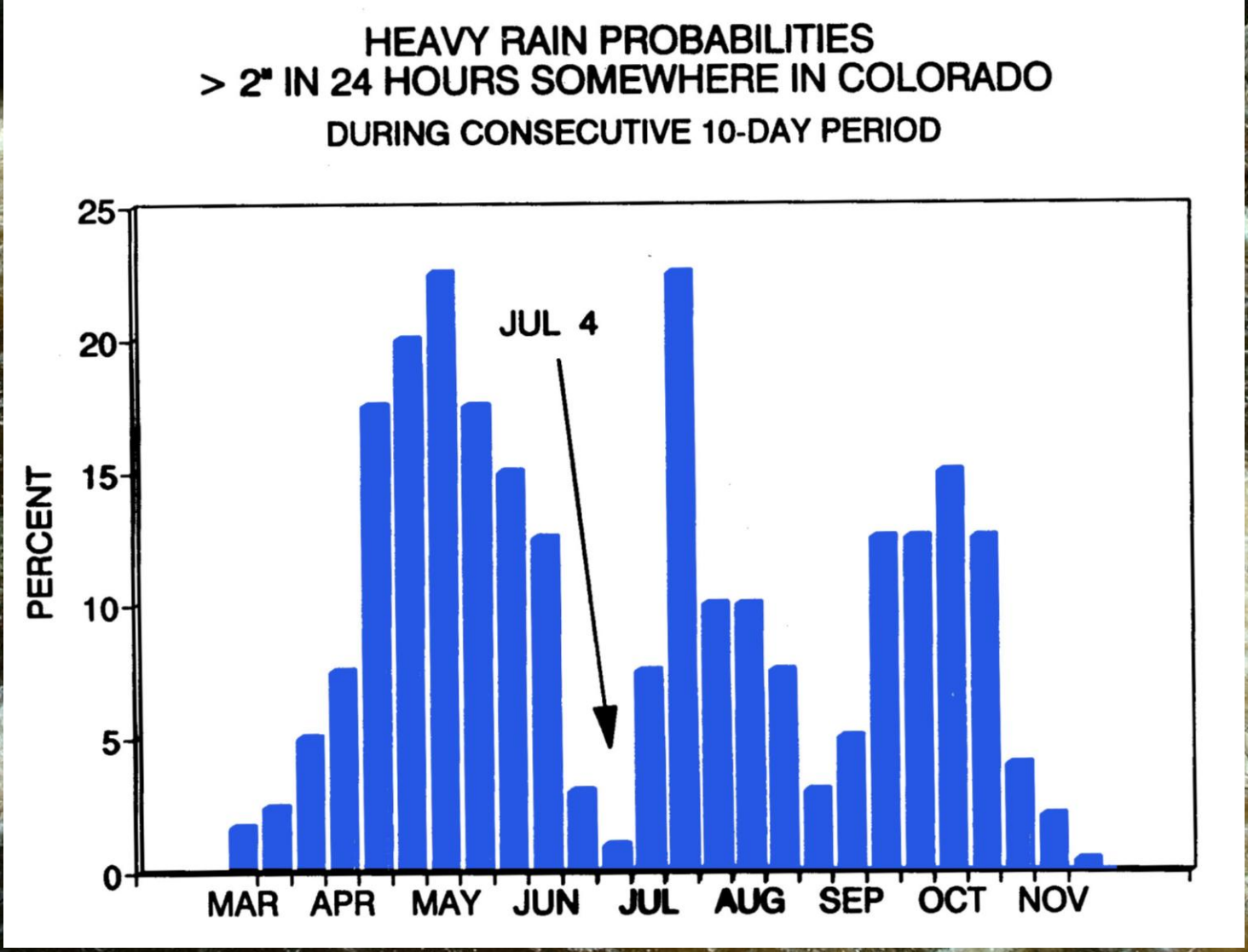
Snowpack accumulates like this – and melts at a predictable time of year



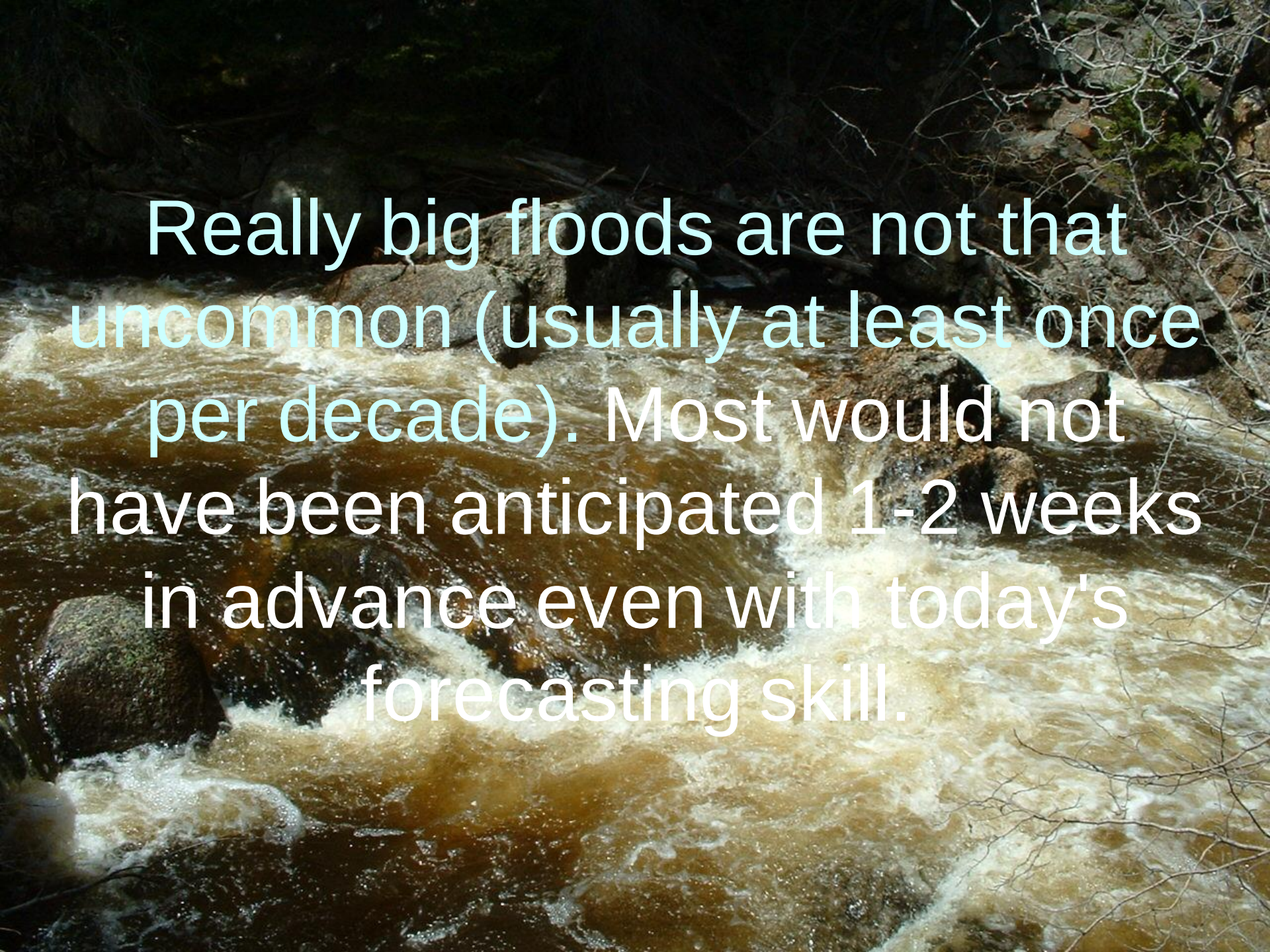

Rain comes in infrequent but occasionally very large events


A small fraction of storms contribute a large fraction of our annual precipitation, especially at lower elevations

We know when heavy rains are most likely



Some Points to Remember:


Really big floods are not that uncommon (usually at least once per decade). Most would not have been anticipated 1-2 weeks in advance even with today's forecasting skill.

Colorado Snowmelt Usually is Well Behaved

Deep and widespread snowpack increases the likelihood for snow melt flooding


Snowmelt floods usually require prolonged very warm temperatures and/or widespread late-season snowpack including snow on south facing slopes

Rain on Snow is "usually" not a problem – but . . . . ??


Most of Colorado's worst floods are rainfall floods

Flash floods are especially problematic over sparsely vegetated sloped surfaces

Floods and drought are NOT mutually exclusive

Intense rains are often highly localized

Fort Collins Rainfall
Jul 27, 4pm to
Jul 28, 11pm
1997

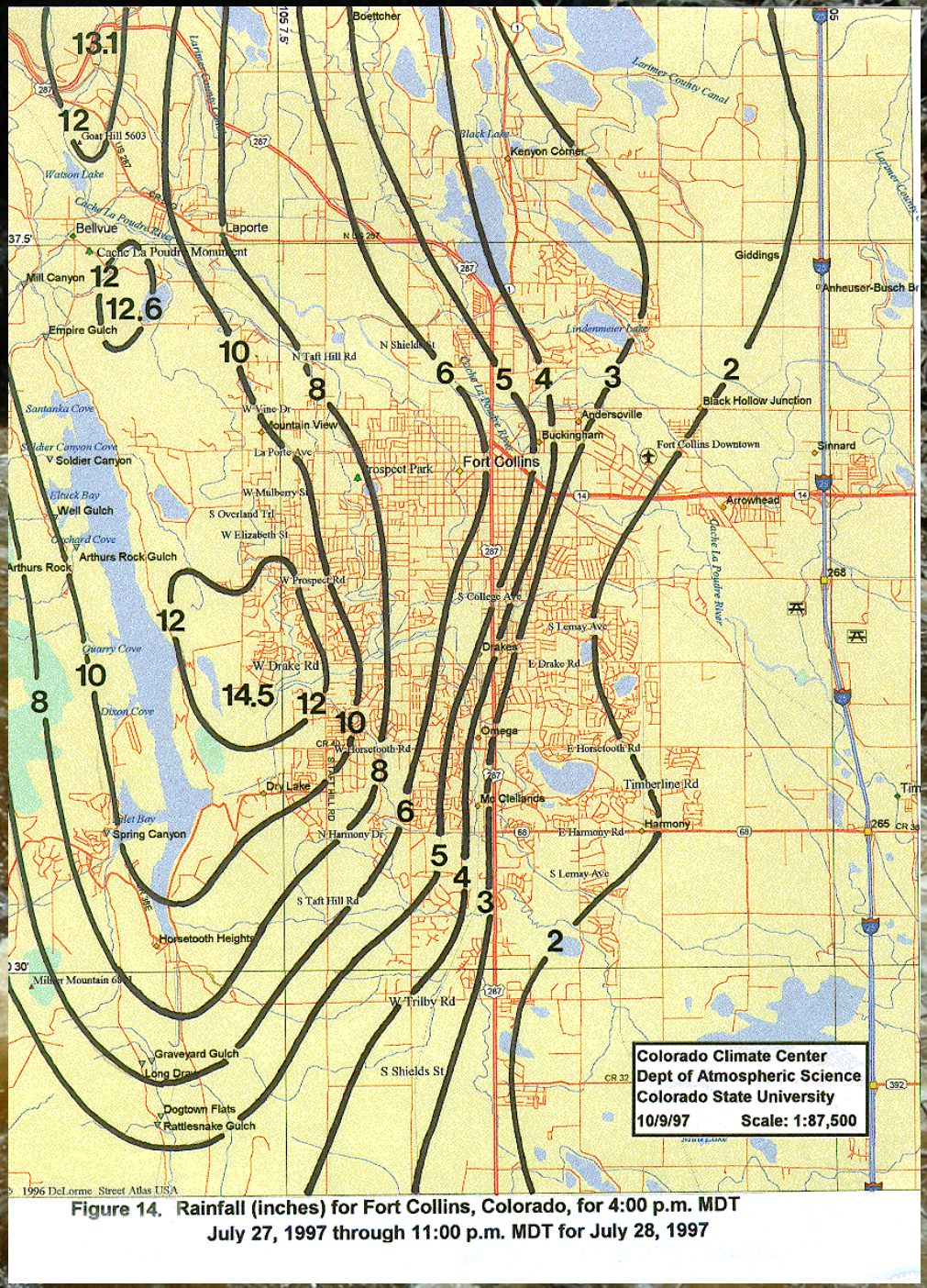
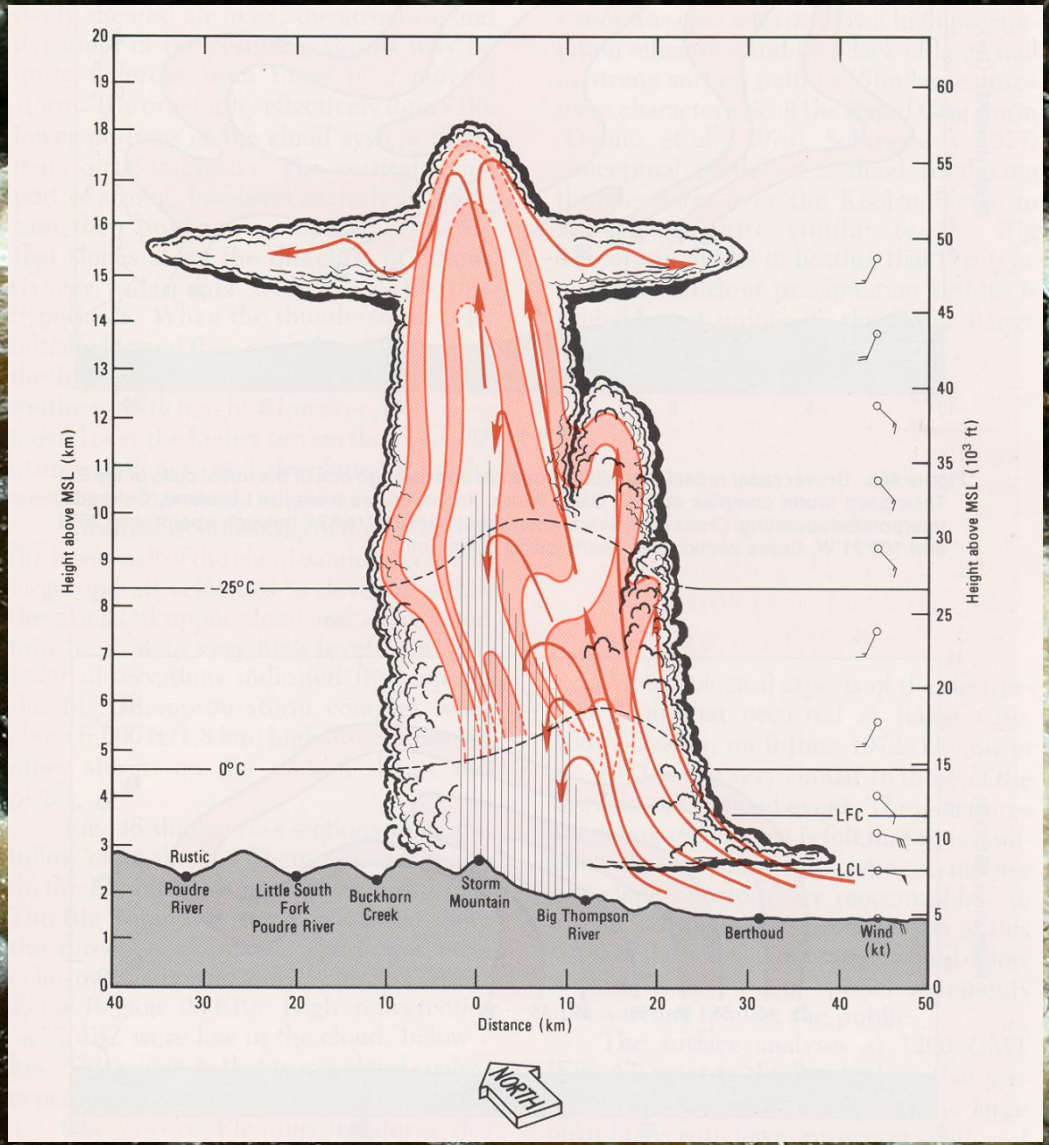


Figure 14. Rainfall (inches) for Fort Collins, Colorado, for 4:00 p.m. MDT July 27, 1997 through 11:00 p.m. MDT for July 28, 1997

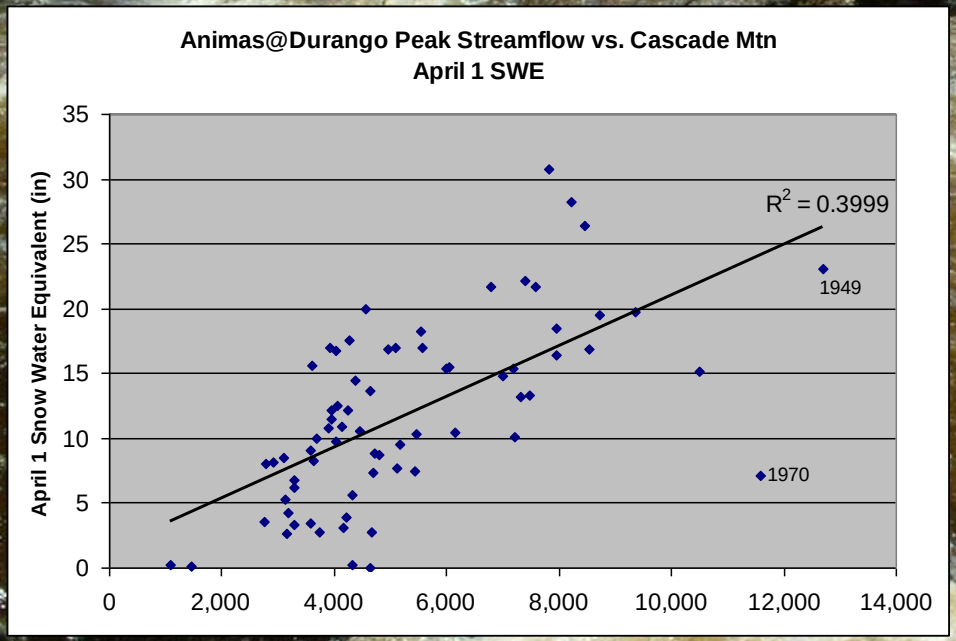
If it rains hard enough, everything is in the "flood plain"

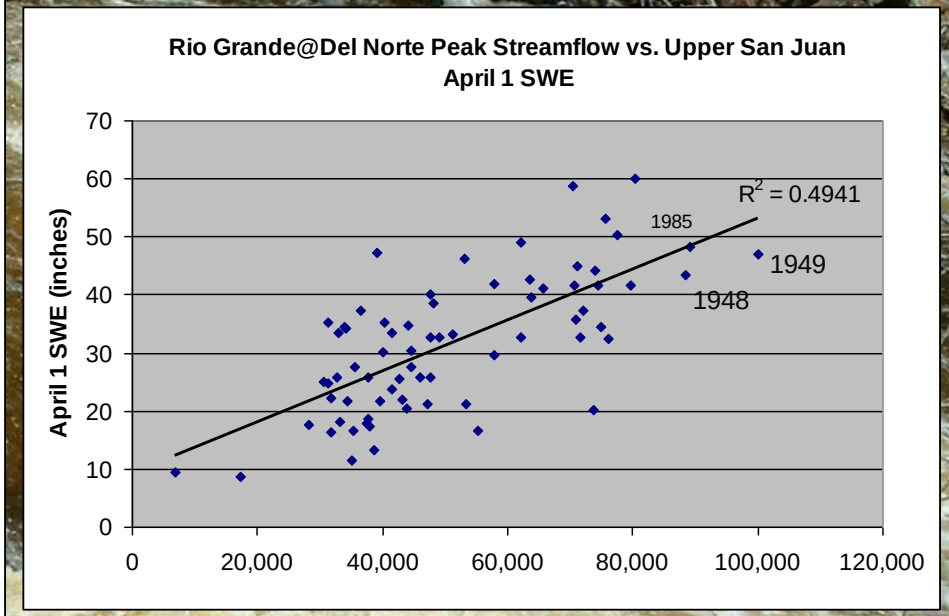


Big Thompson Flood

Late April through Mid June is our main season for "volume" floods

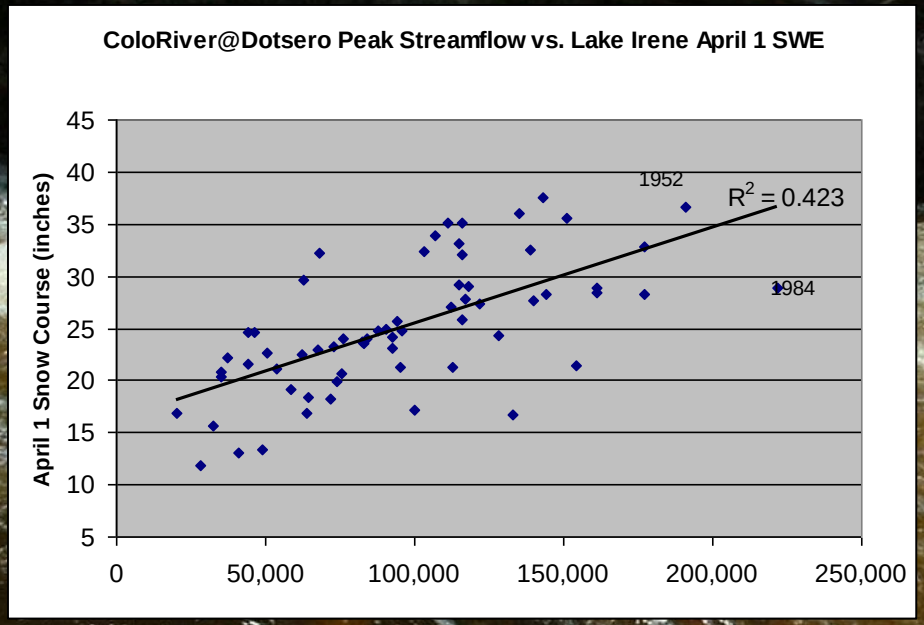
What do we know about how Spring Snowpack relates to Peak Streamflow?

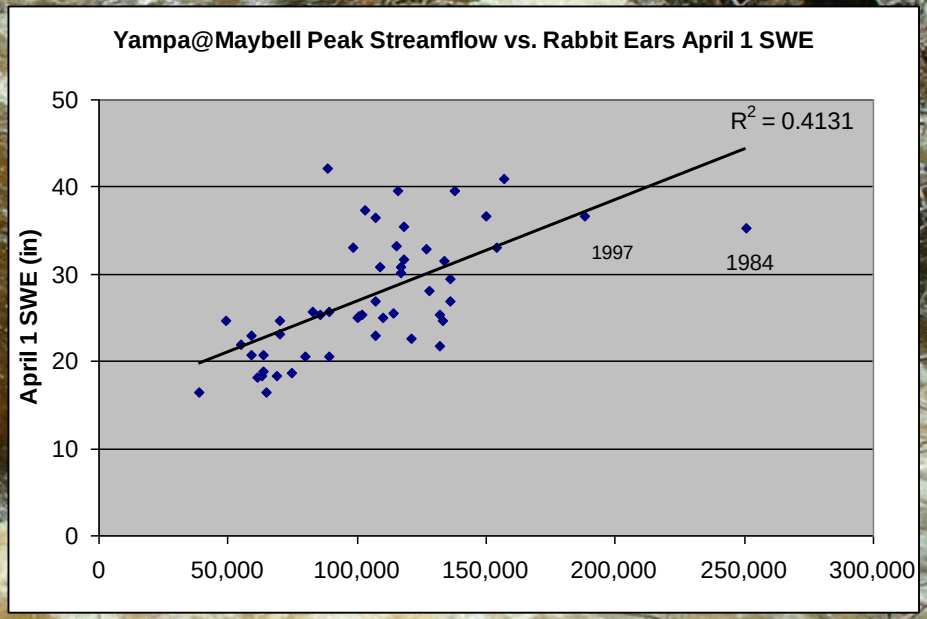




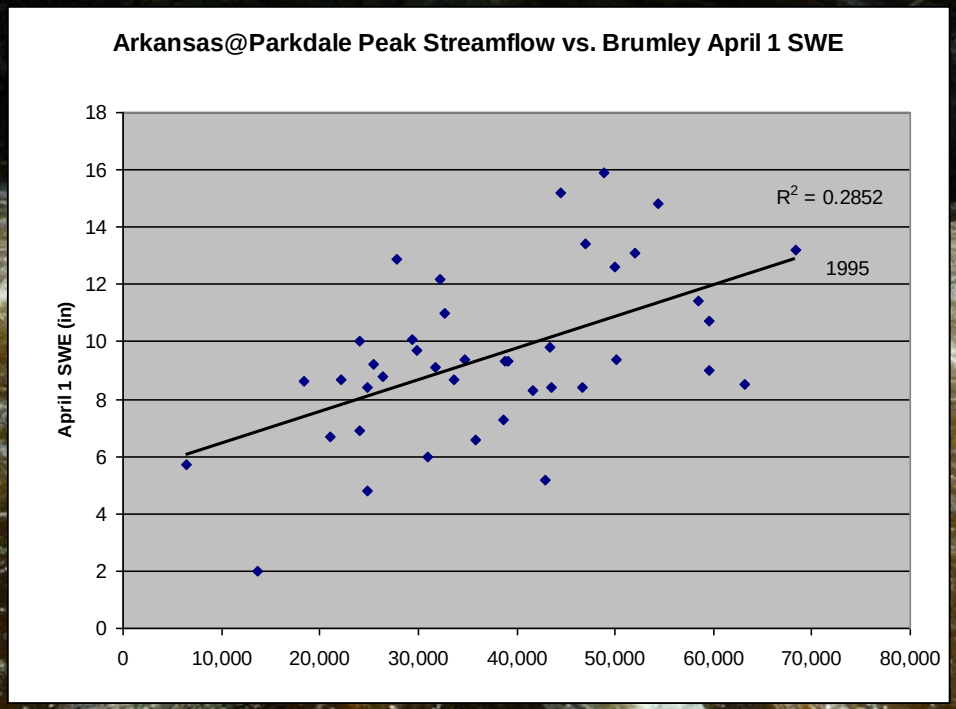
Peak Water Year Streamflow in cfs vs.
April 1 Snow Water Equivalent (SWE) in inches

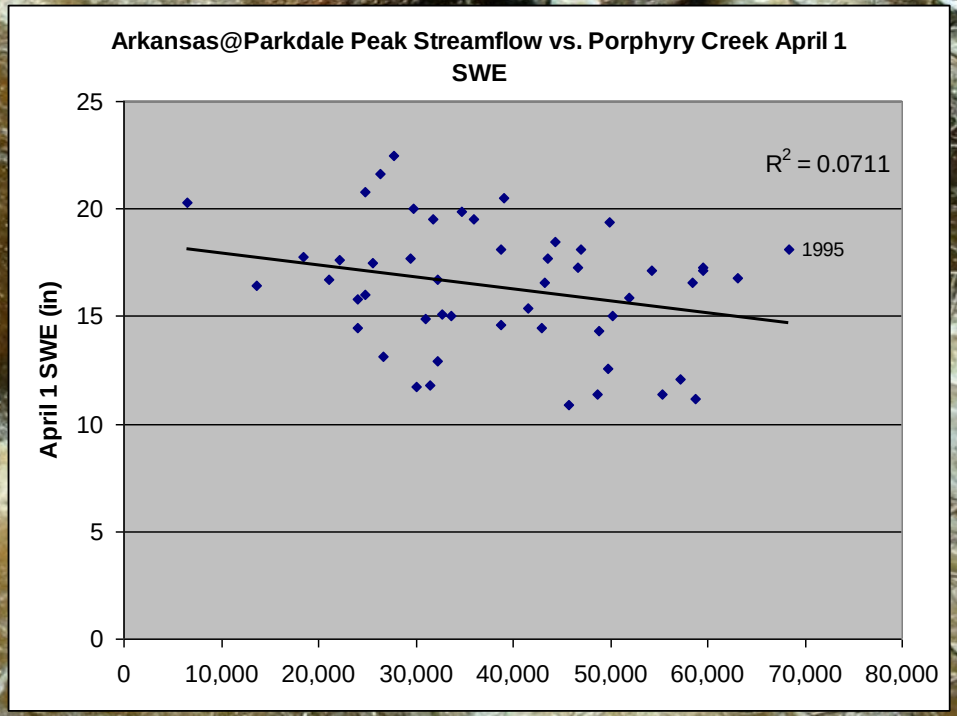
Peak Streamflow vs. April 1 SWE



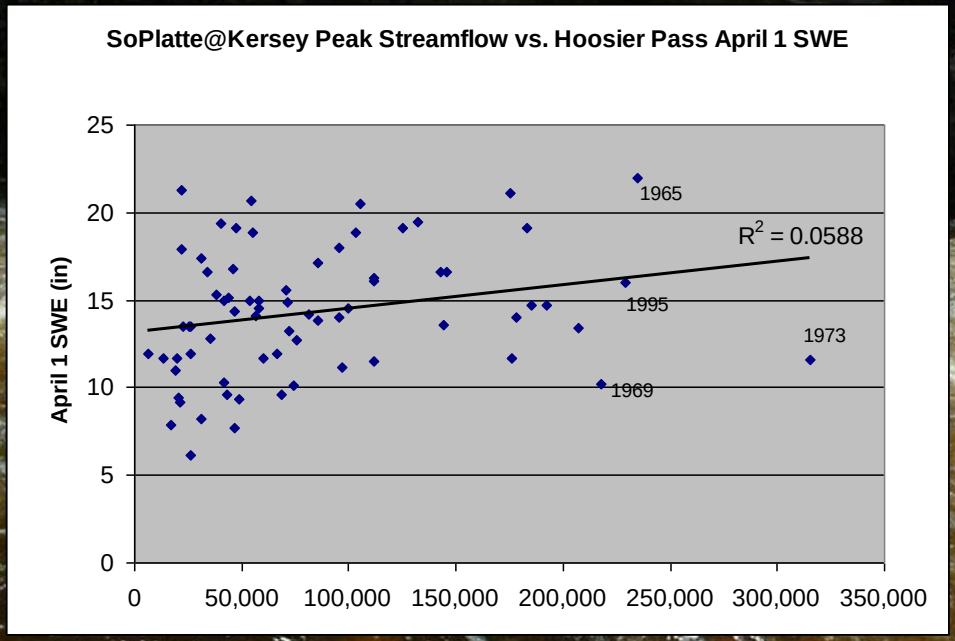


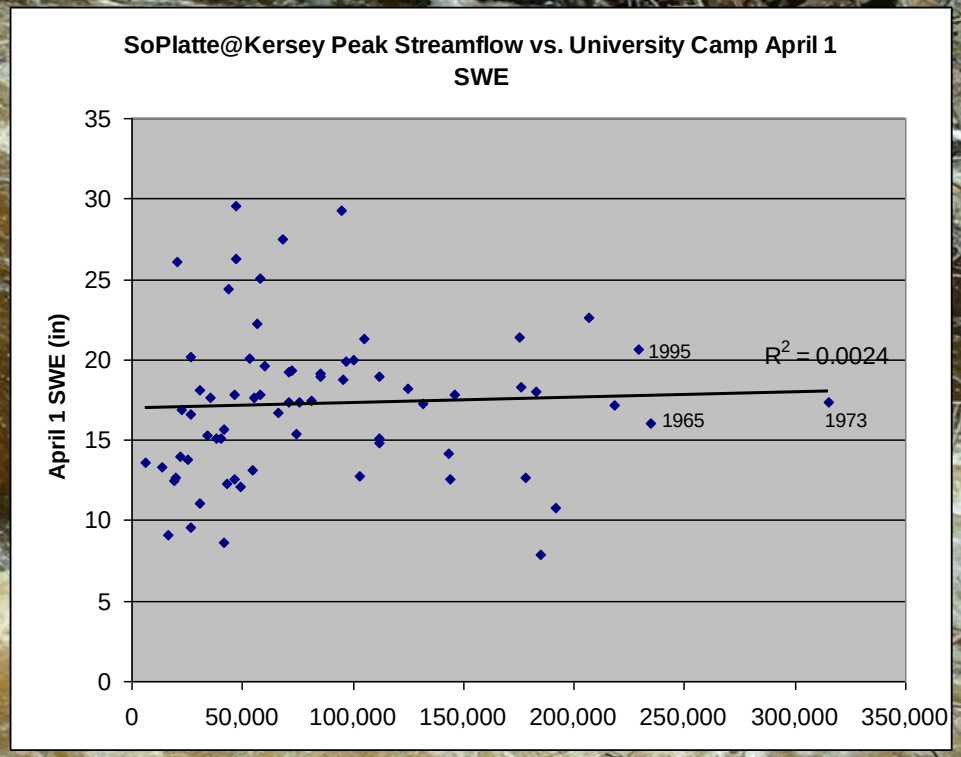
Peak Streamflow vs. April 1 SWE



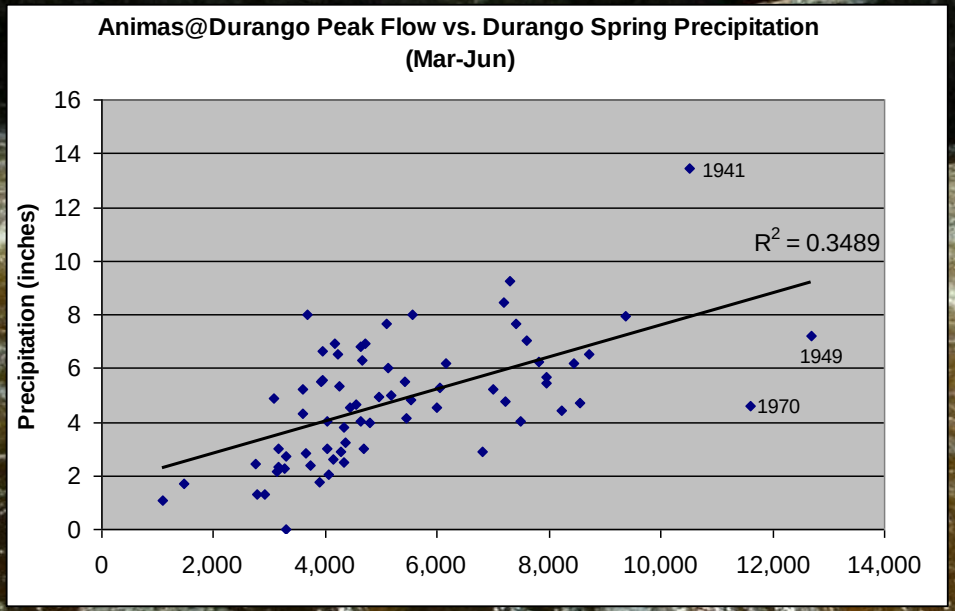


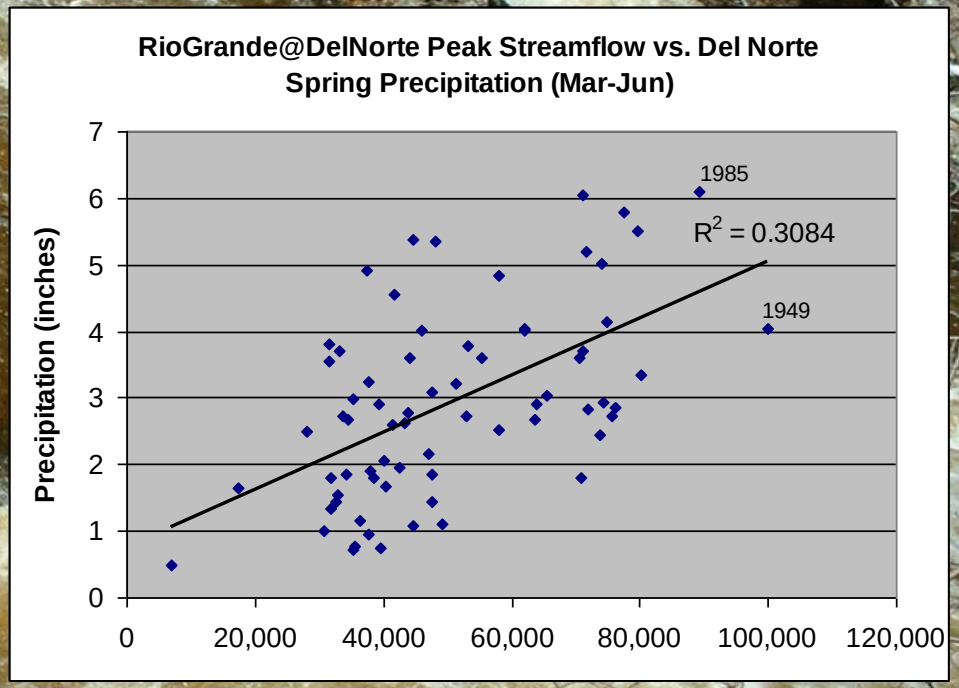
Peak Streamflow vs. April 1 SWE



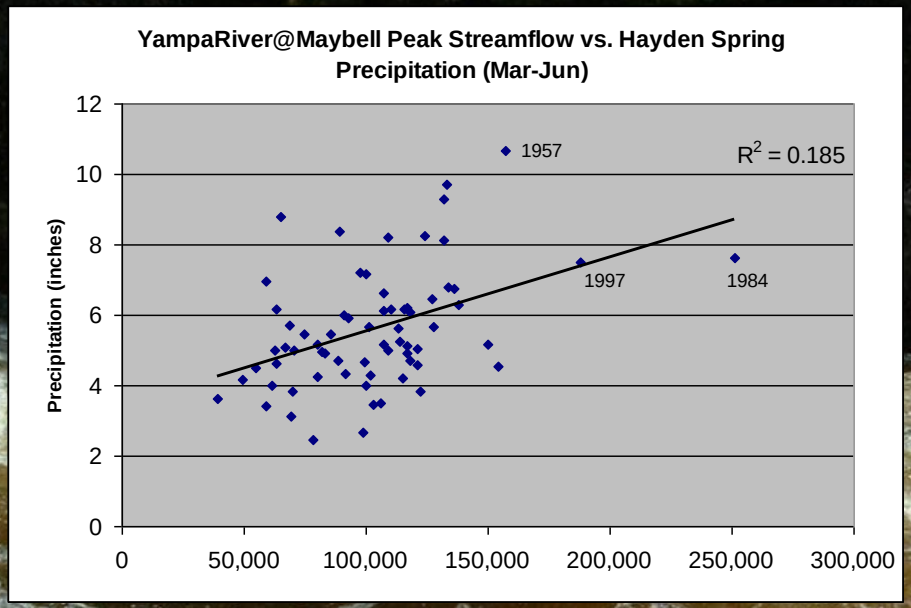


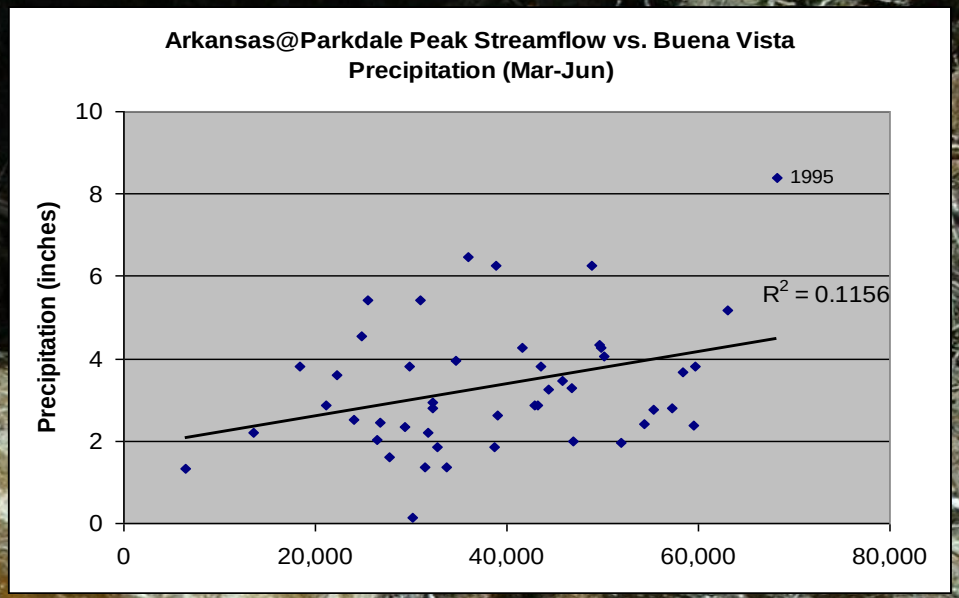
How about Peak Streamflow vs. Spring Precipitation?

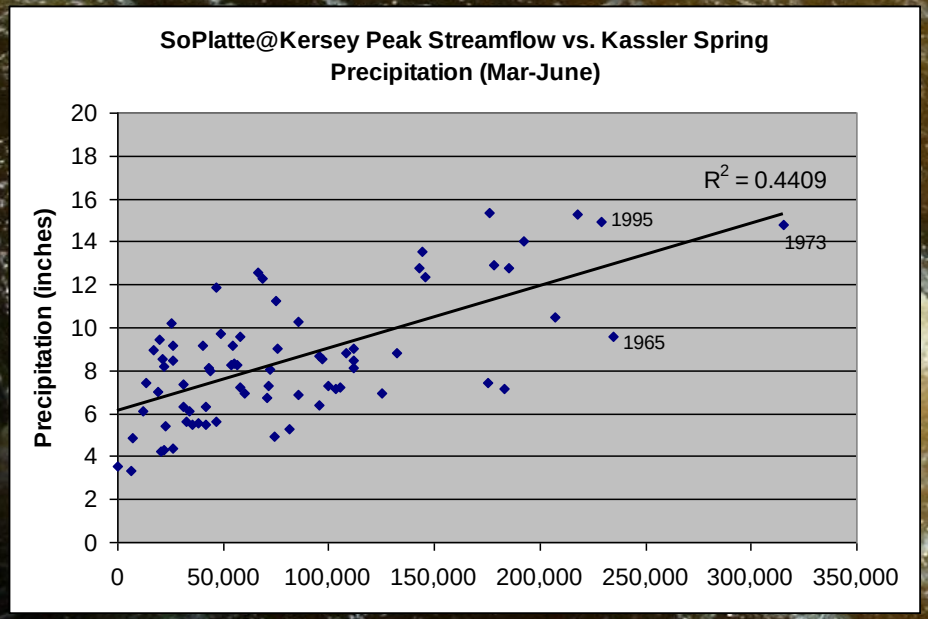


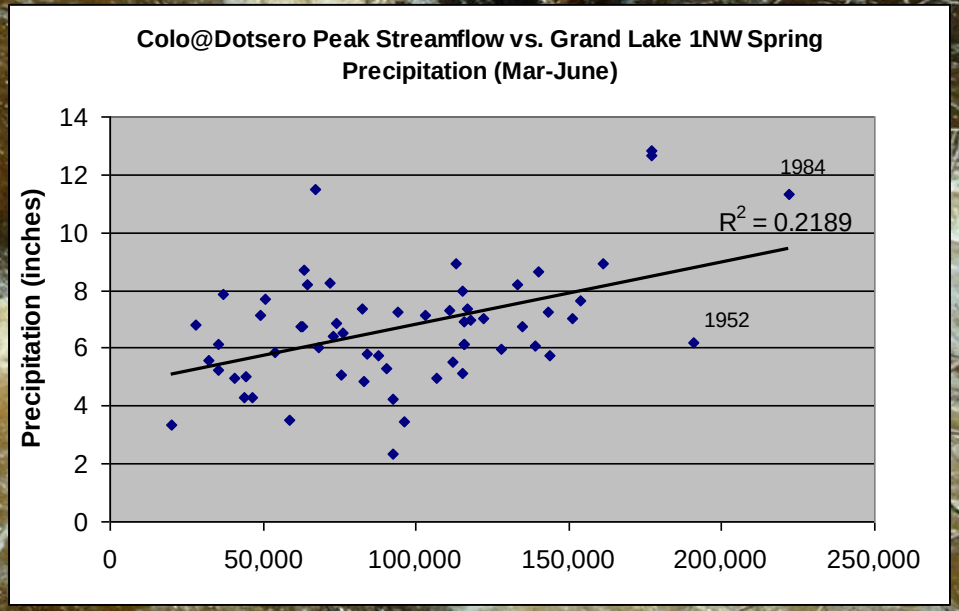


Peak Water Year Streamflow in cfs vs. Spring Precipitation (Mar-June) in inches

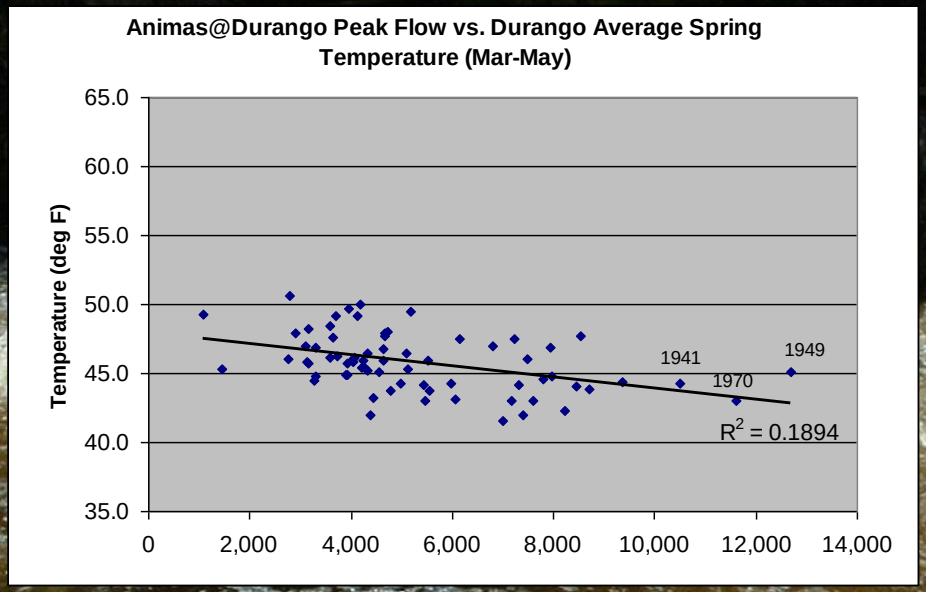

YampaRiver@Maybell Peak Streamflow vs. Hayden Spring Precipitation (Mar-Jun)
Precipitation (inches)
0
2
4
6
8
10
12
0
50,000
100,000
150,000
200,000
250,000
300,000
1957
1997
1984
R2 = 0.185

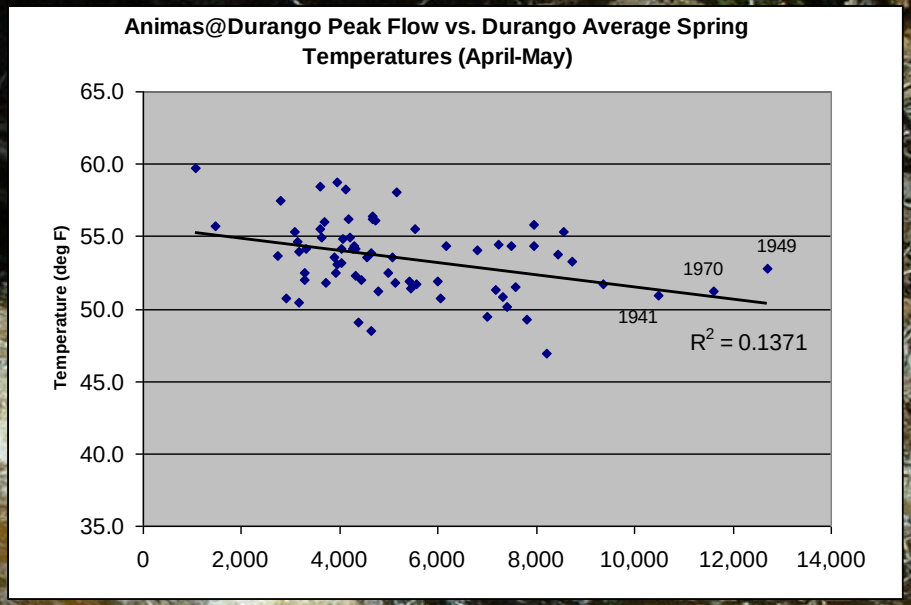

Arkansas@Parkdale Peak Streamflow vs. Buena Vista Precipitation (Mar-Jun)
Precipitation (inches)
0
2
4
6
8
10
0
20,000
40,000
60,000
80,000
1995
R2 = 0.1156

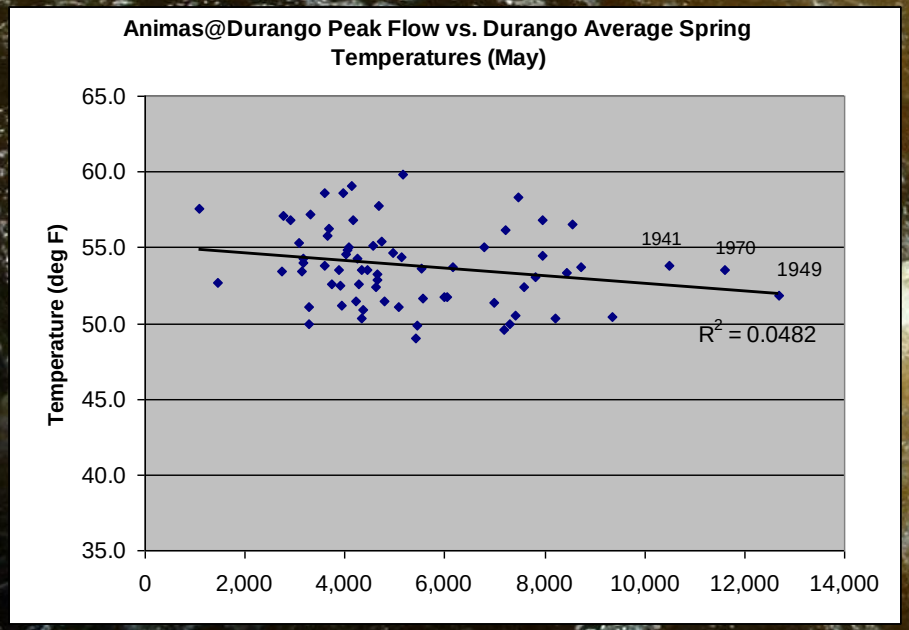

SoPlatte@Kersey Peak Streamflow vs. Kassler Spring Precipitation (Mar-June)
Precipitation (inches)
0
2
4
6
8
10
12
14
16
18
20
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
R2 = 0.4409
1995
1973
1965


Colo@Dotsero Peak Streamflow vs. Grand Lake 1NW Spring Precipitation (Mar-June)
Precipitation (inches)
0
2
4
6
8
10
12
14
0
50,000
100,000
150,000
200,000
250,000
1984
R2 = 0.2189
1952

Animas Peak Streamflow vs. Durango Ave Temps

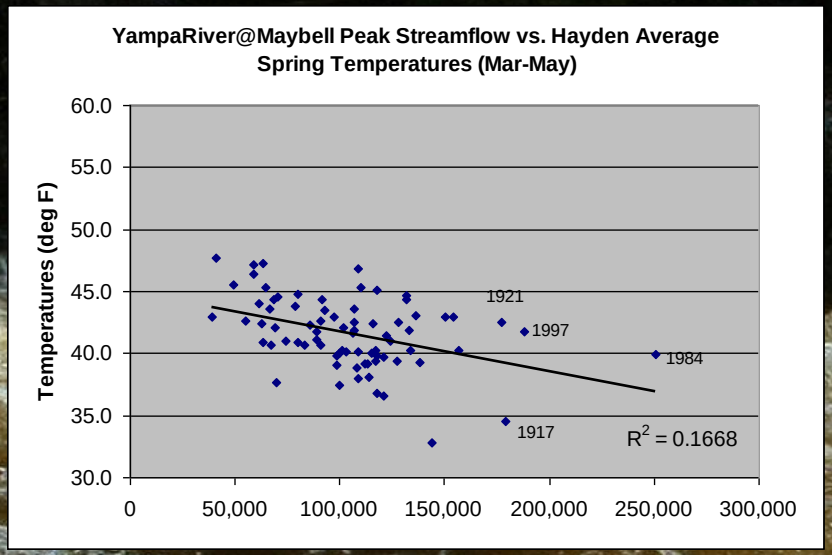


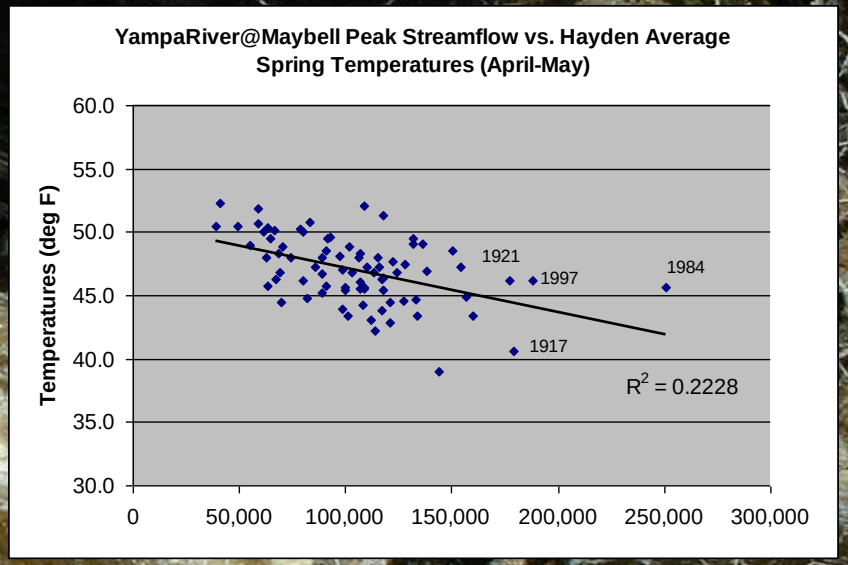


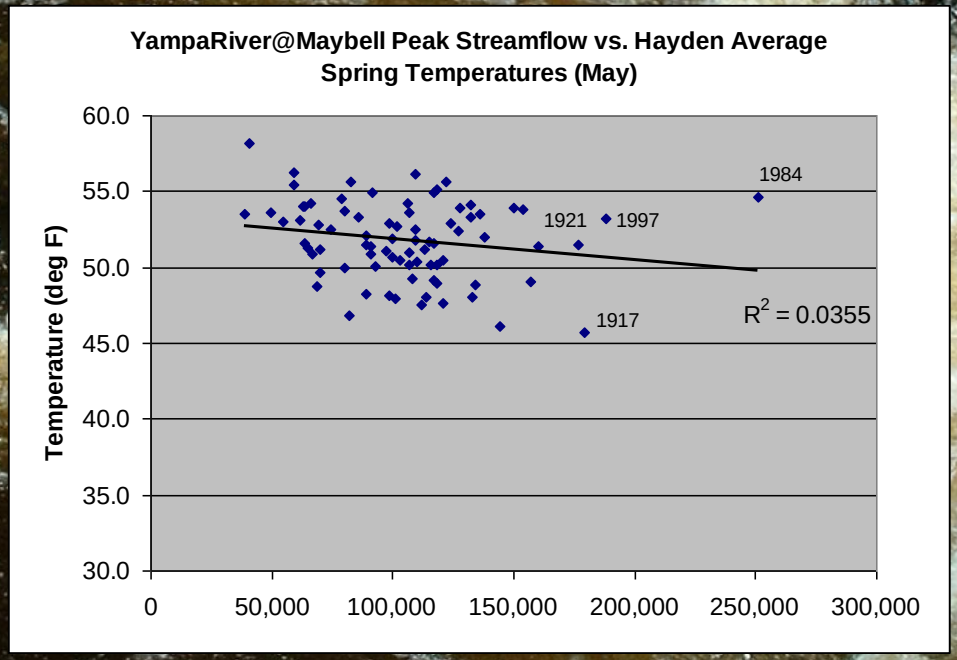


Peak Water Year Streamflow in cfs vs. Average Temperatures in degrees F

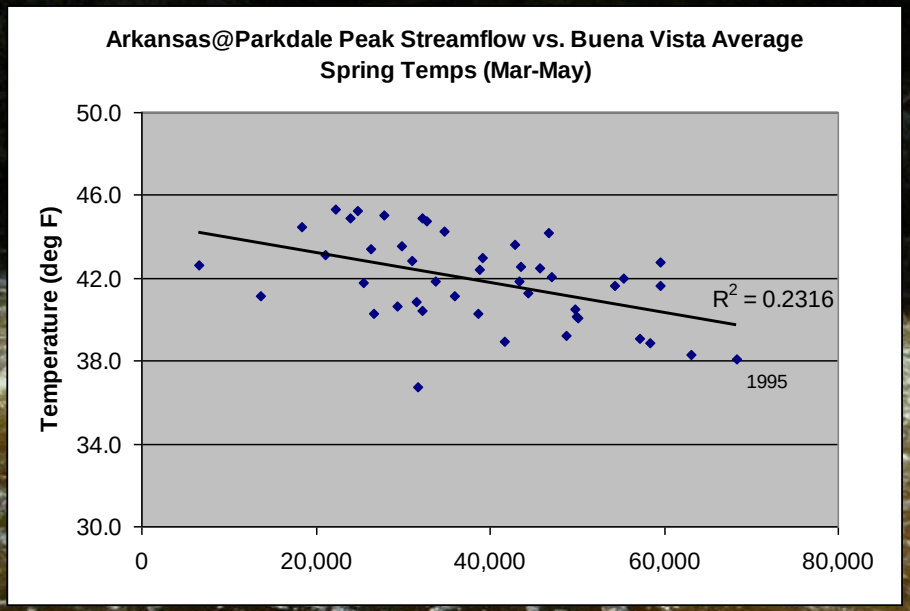
Yampa Peak Streamflow vs. Hayden Ave Temps

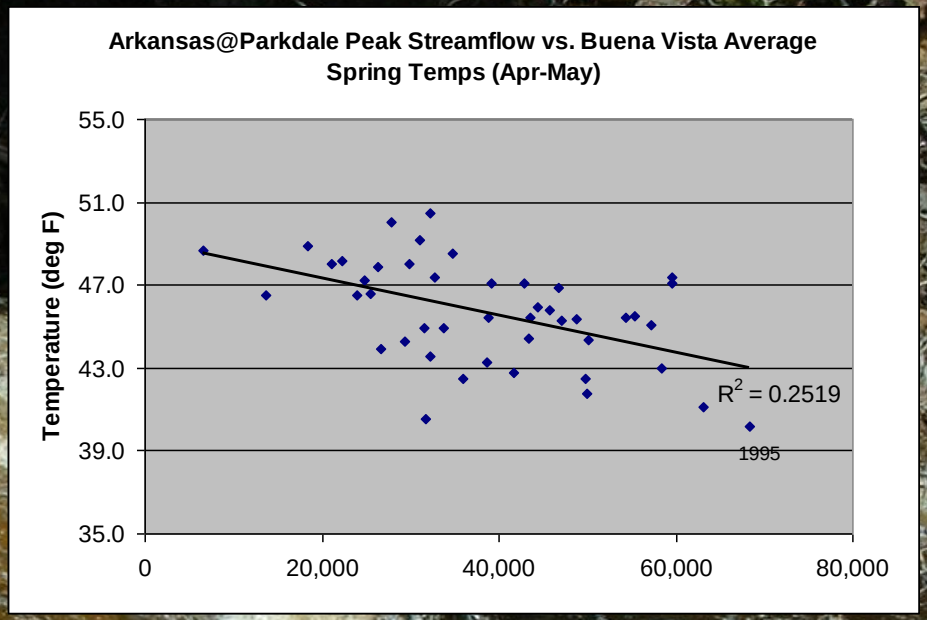


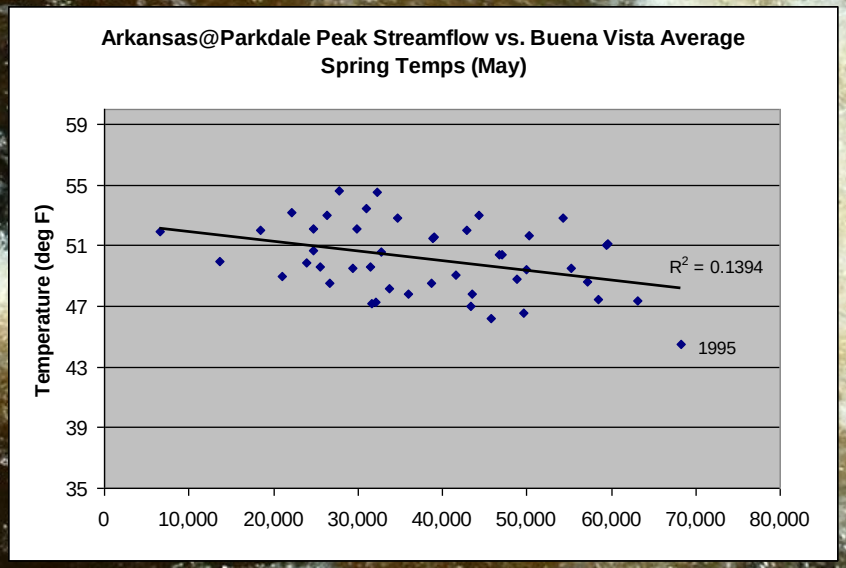




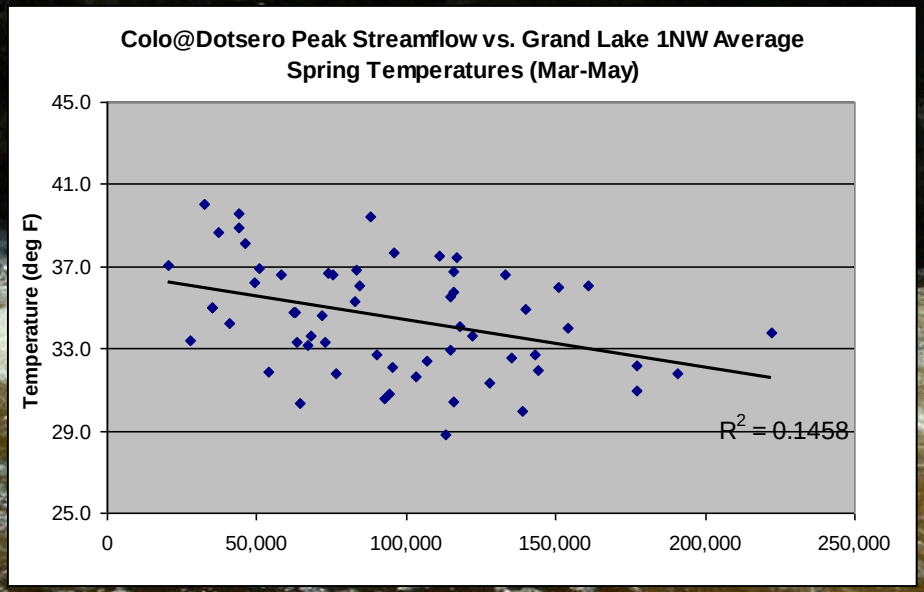
Arkansas Peak Streamflow vs. Buena Vista Ave Temps

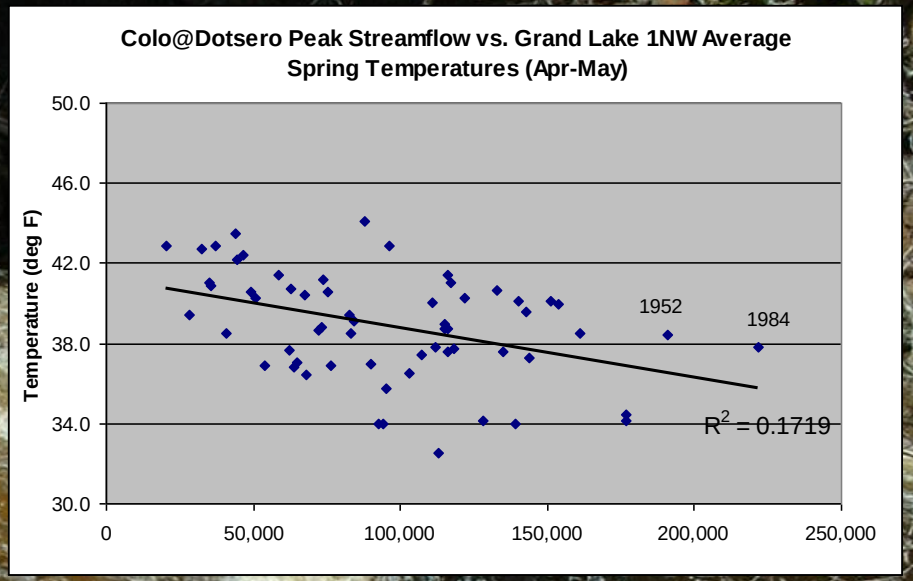


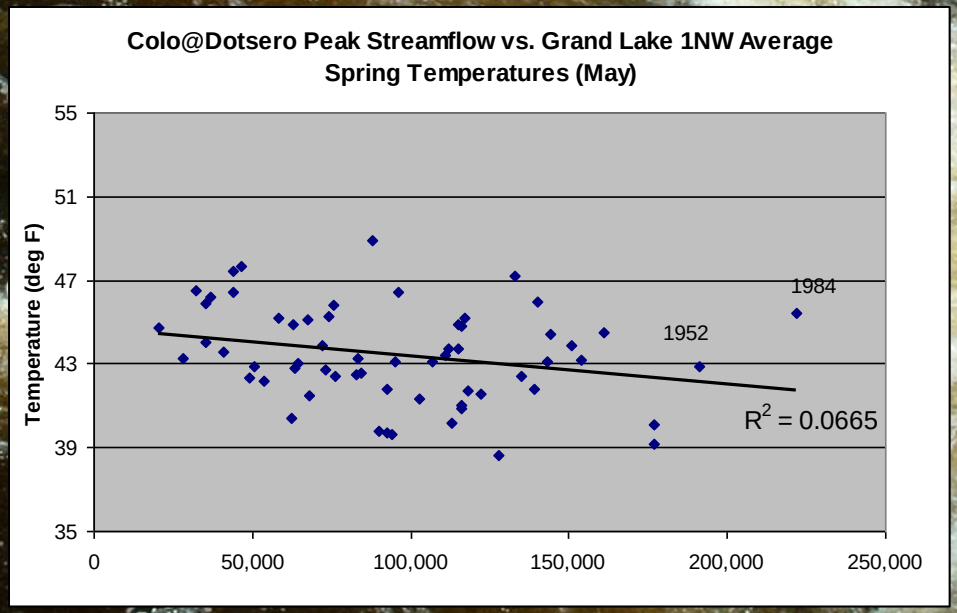




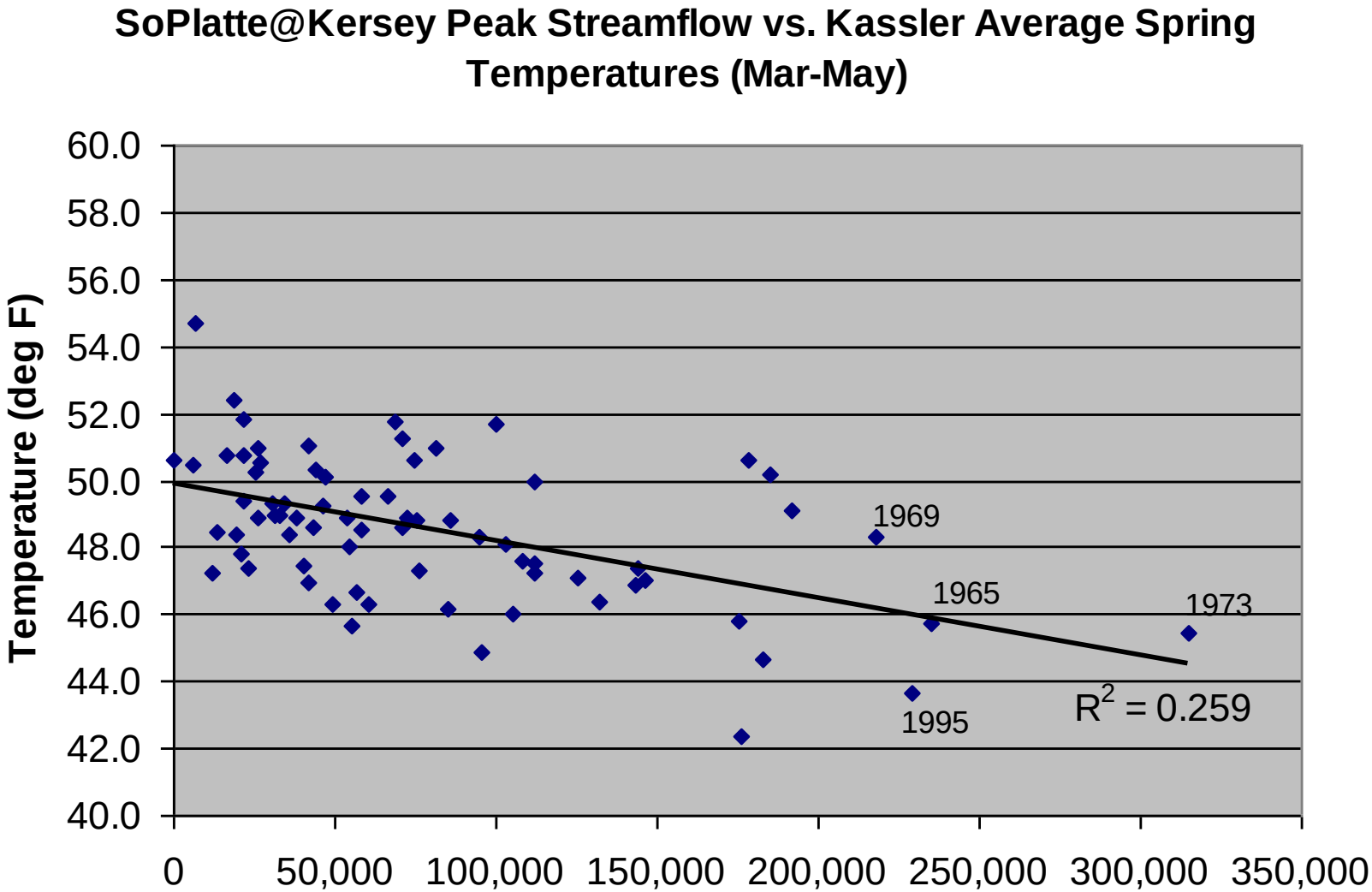
Colorado Peak Streamflow vs. Grand Lake 1NW Ave Temps







South Platte Streamflow vs. Kassler Ave Temps



Colorado Climate Center

Colorado State University
Knowledge to Go Places

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu/droughtpresentations.php