Perspective on Precipitation

Nolan Doesken
Colorado Climate Center
Department of Atmospheric Science
Colorado State University

Paonia Reservoir
August 2012

WSWC Workshop on Hydroclimate Monitoring Systems and Measurement Needs

Presented 24 June 2014

San Diego, CA

With help from Wendy Ryan and Zach Schwalbe

Topics we will cover today

- Some background
- Examples of commonly used products relying on precipitation data
- The example – Colorado Floods of September 2013
- The issue of "Data Quality"
- What our "users" think they need (results of NIDIS UCRB NIDIS interviews)

A short background

- In 1973 the federal government abolished the “State Climatologist” program nationwide leaving Colorado without
- Later that same year, Colorado re-established the State Climate program with support through the Colorado Agricultural Experiment Station at Colorado State University.

Colorado
Agricultural Experiment Station

Our Mission

- The Colorado Climate Center at CSU provides valuable climate expertise to the residents of the state through its threefold program of:

  1) ***Climate Monitoring*** (data acquisition, analysis, and archiving),

  2) ***Climate Research***

  3) ***Climate Services***.(providing data, analysis, climate education and outreach)

Basically, we keep track of numbers -- climate numbers

-- lots and lots of numbers

We are “Climate Accountants”

and we LOVE IT!

Monitoring our Climate

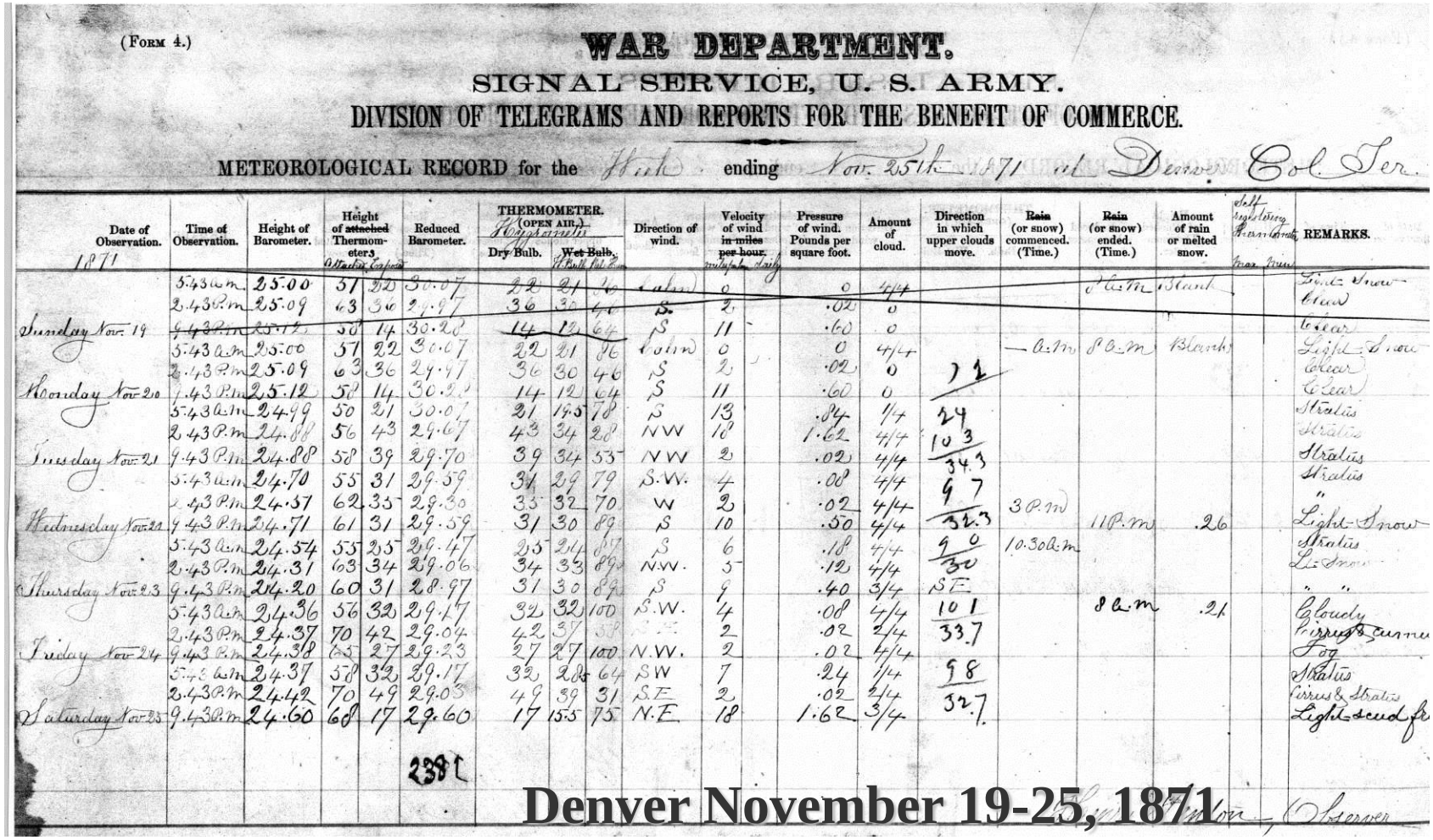
- Elements: temperature, ***precipitation***, snow, wind, solar, evaporation, soil temperatures, humidity, clouds, etc.

In 2012, Colorado held a "Year for Water Celebration"

Ever since, I've been promoting
"Hug your Water Manager"
"Thank your Water Measurers"

Information users need to know where climate and water data come from and that **good data are valuable** but challenging to obtain

Systematic weather data collection
began in Colorado in the 1870s and 1880s



(Form 4.)

WAR DEPARTMENT.

SIGNAL SERVICE, U. S. ARMY.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE.

METEOROLOGICAL RECORD for the Week ending Nov. 25th 1871 at Denver Col. Ter.

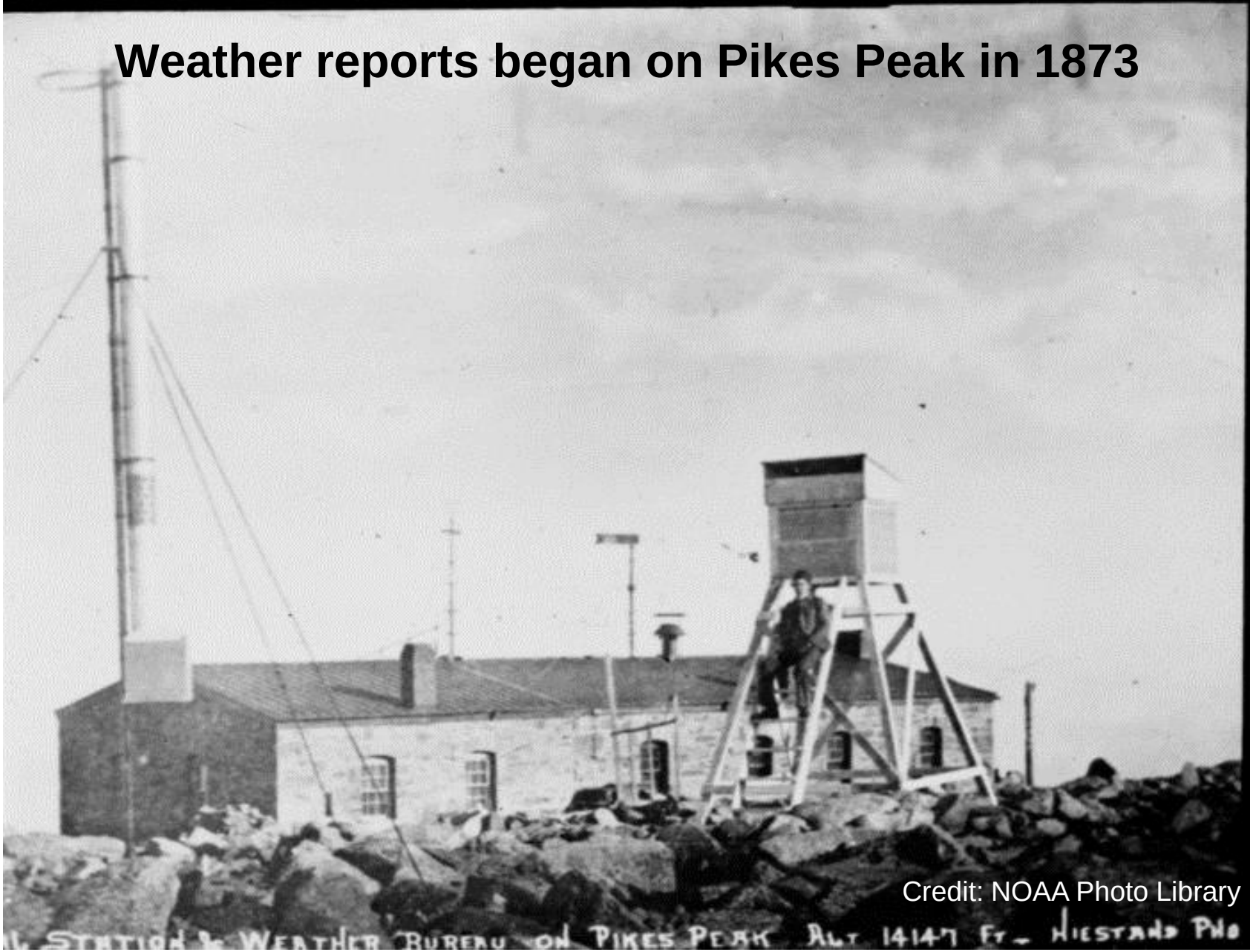
Date of Observation. 1871	Time of Observation.	Height of Barometer.	Height of ~~attached~~ Thermometer. Attached Cistern		Reduced Barometer.	Thermometer. (Open Air.) Dry Bulb.	Wet Bulb. Wet Bulb. Dew Point		Direction of wind.	Velocity of wind ~~in miles per hour~~ miles per hour. Daily	Pressure of wind. Pounds per square foot.	Amount of cloud.	Direction in which upper clouds move.	Rain (or snow) commenced. (Time.)	Rain (or snow) ended. (Time.)	Amount of rain or melted snow.	Self registering Rain Gauge. Hour. Minutes.	REMARKS.
	5.43 a.m.	25.00	37	22	30.07	22	21	86	calm	0	0	4/4			8 a.m.	Blank		Fine Snow
	2.43 P.m.	25.09	63	36	29.97	36	30	46	S.	2	.02	0						Clear
Sunday Nov. 19	~~9.43 P.m.~~	~~25.12~~	58	14	30.28	~~14~~	~~12~~	~~64~~	S	11	.60	0						Clear
	5.43 a.m.	25.00	37	22	30.07	22	21	86	calm	0	0	4/4		a.m.	8 a.m.	Blank		Light Snow
	2.43 P.m.	25.09	63	36	29.97	36	30	46	S	2	.02	0	12					Clear
Monday Nov. 20	9.43 P.m.	25.12	58	14	30.22	14	12	64	S	11	.60	0						Clear
	5.43 a.m.	24.99	50	21	30.07	21	19.5	78	S	13	.84	1/4	24					Stratus
	2.43 P.m.	24.88	56	43	29.67	43	34	28	NW	18	1.62	4/4	103					Stratus
Tuesday Nov. 21	9.43 P.m.	24.88	58	39	29.70	39	34	53	NW	2	.02	4/4	34.3					Stratus
	5.43 a.m.	24.70	55	31	29.59	34	29	79	S.W.	4	.08	4/4	97					Stratus
	2.43 P.m.	24.37	62	35	29.30	33	32	70	W	2	.02	4/4	32.3	3 P.m.				"
Wednesday Nov. 22	9.43 P.m.	24.71	61	31	29.59	31	30	89	S	10	.50	4/4	90		11 P.m.	.26		Light Snow
	5.43 a.m.	24.54	55	25	29.47	25	24	87	S	6	.18	4/4	30	10.30 a.m.				Stratus
	2.43 P.m.	24.31	63	34	29.06	34	33	89	N.W.	5	.12	4/4						Lt. Snow
Thursday Nov. 23	9.43 P.m.	24.20	60	31	28.97	31	30	89	S	9	.40	3/4	SE					" "
	5.43 a.m.	24.36	56	32	29.17	32	32	100	S.W.	4	.08	4/4	101		8 a.m.	.21		Cloudy
	2.43 P.m.	24.37	70	42	29.04	42	37	38	[illegible]	2	.02	2/4	33.7					Cirrus & Cumu
Friday Nov. 24	9.43 P.m.	24.38	65	27	29.23	27	27	100	N.W.	2	.02	4/4						Fog
	5.43 a.m.	24.37	58	32	29.17	32	28	64	SW	7	.24	1/4	98					Stratus
	2.43 P.m.	24.42	70	49	29.03	49	39	31	S.E.	2	.02	2/4	32.7					Cirrus & Stratus
Saturday Nov. 25	9.43 P.m.	24.60	68	17	29.60	17	15.5	75	N.E.	18	1.62	3/4						Light scud fr

238 C

Observer

Denver November 19-25, 1871

Weather reports began on Pikes Peak in 1873

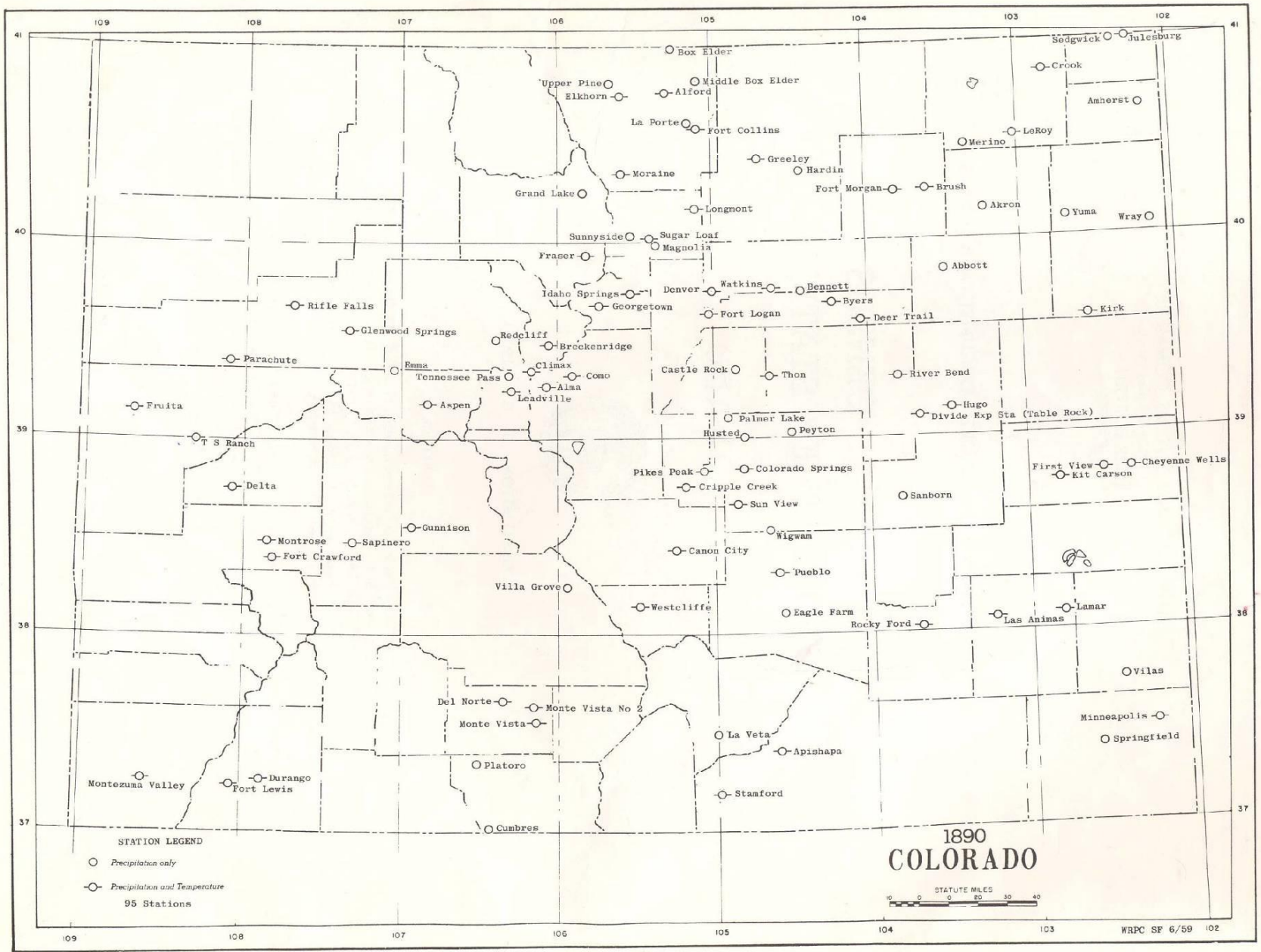


Credit: NOAA Photo Library

Reports were sent by telegraph every few hours

Stories abounded in the national media of the rigors of Colorado Climate

By 1890 a robust statewide weather reporting network was in place



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

Photo by Christopher Davey

Each passing year reveals more about our climate and its impacts –

Daily weather

Spatial patterns,

seasonal cycles,

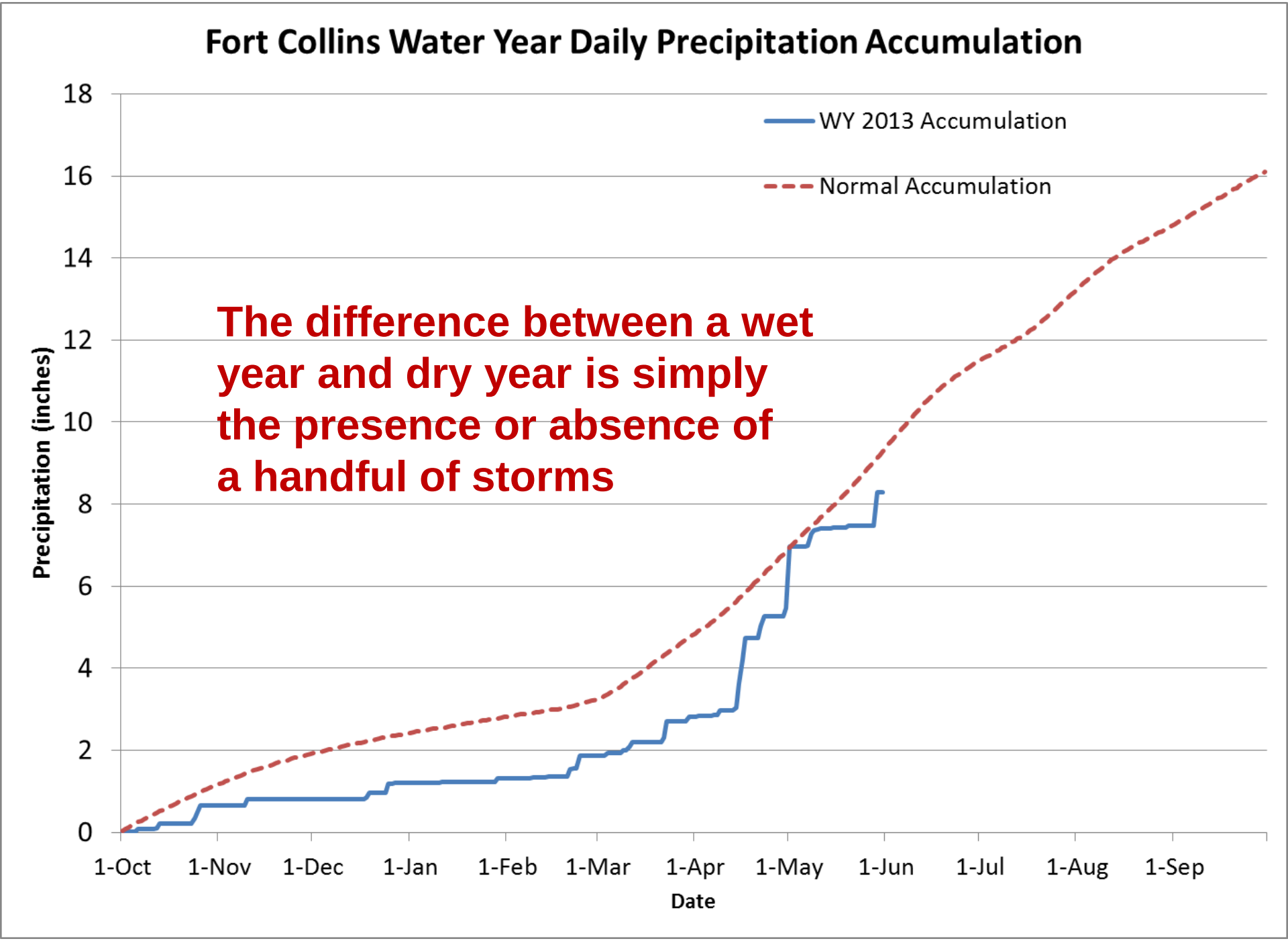
year to year variations

occasional wild extremes

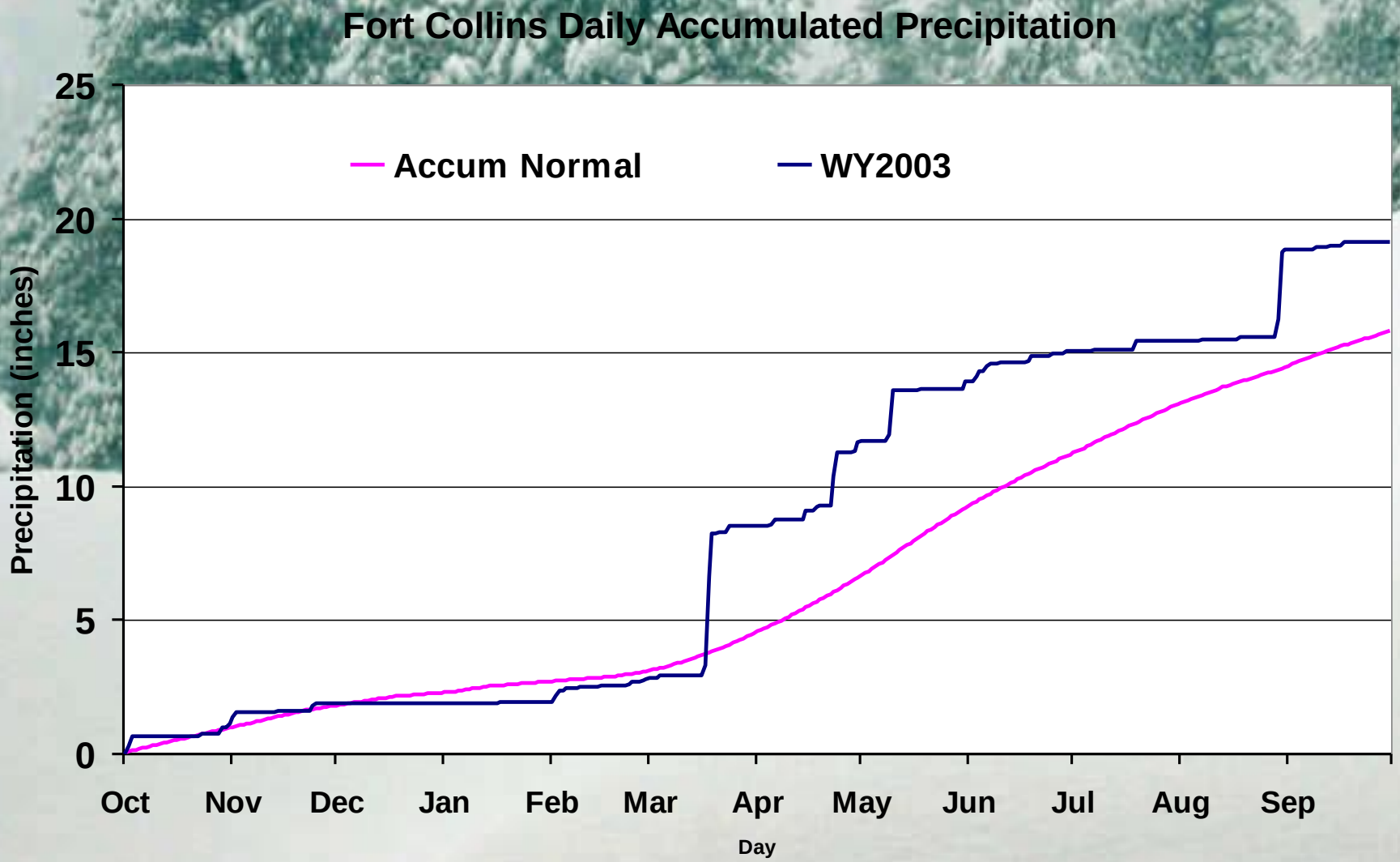
Snow, Snow, Snow

Long-term changes – what comes next

We’ve started with Point Data, and expanded from there


Fort Collins Water Year Daily Precipitation Accumulation
WY 2013 Accumulation
Normal Accumulation
The difference between a wet year and dry year is simply the presence or absence of a handful of storms
Precipitation (inches)
0
2
4
6
8
10
12
14
16
18
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
Date

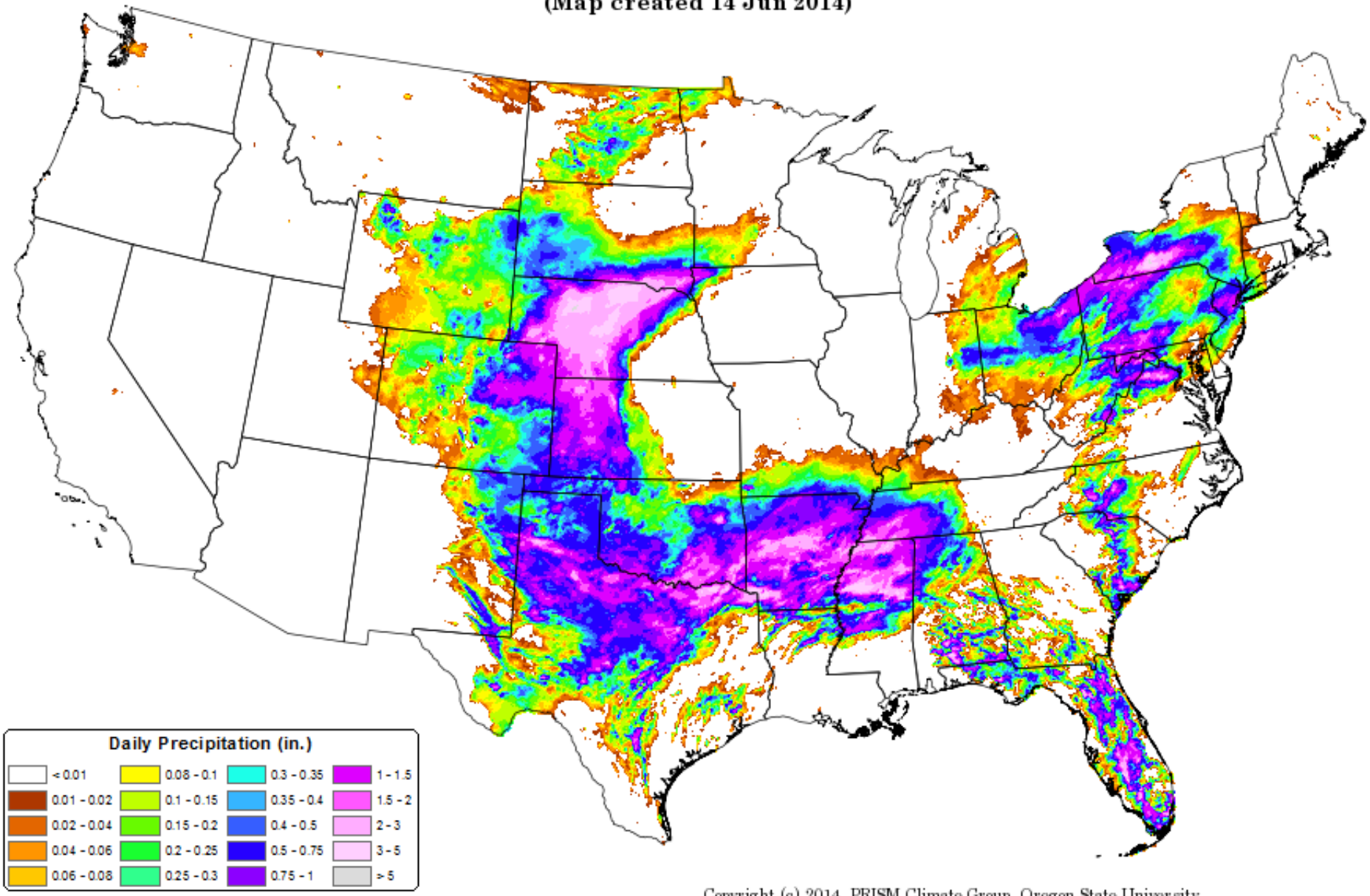
A few storms contribute a large fraction of the annual precipitation in many years



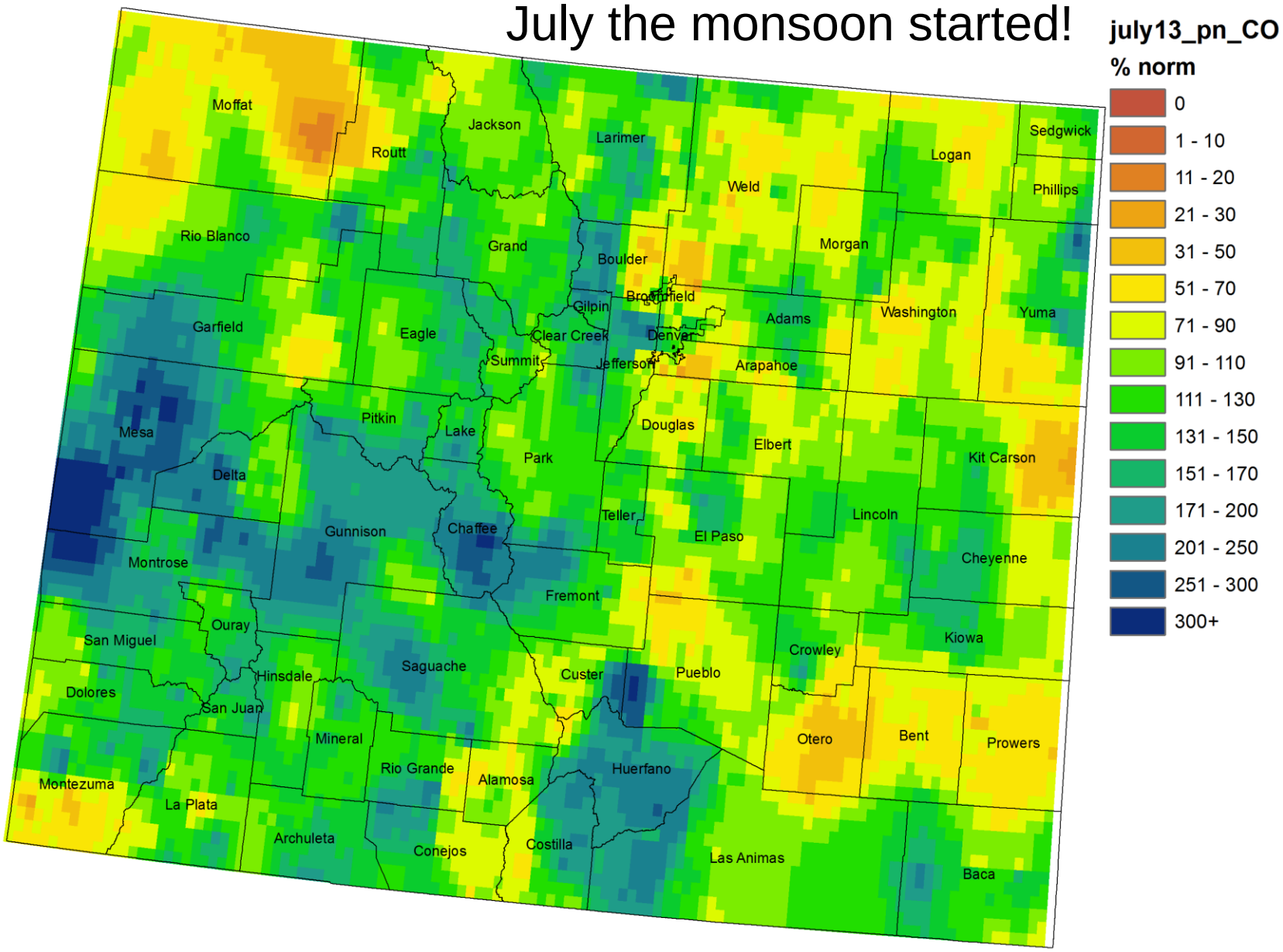
Total Precipitation: 09 June 2014

Period ending 7 AM EST 09 Jun 2014

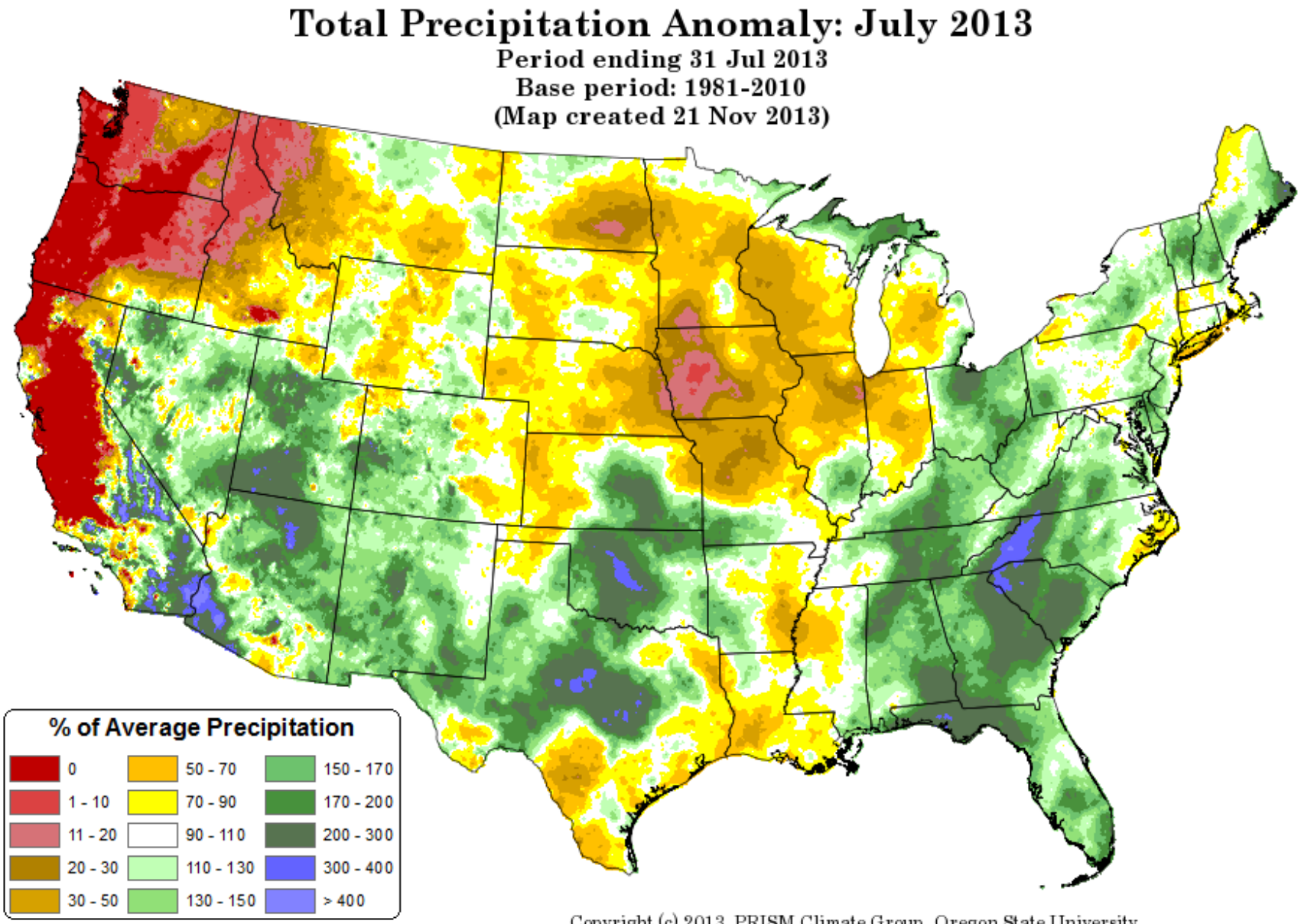
(Map created 14 Jun 2014)



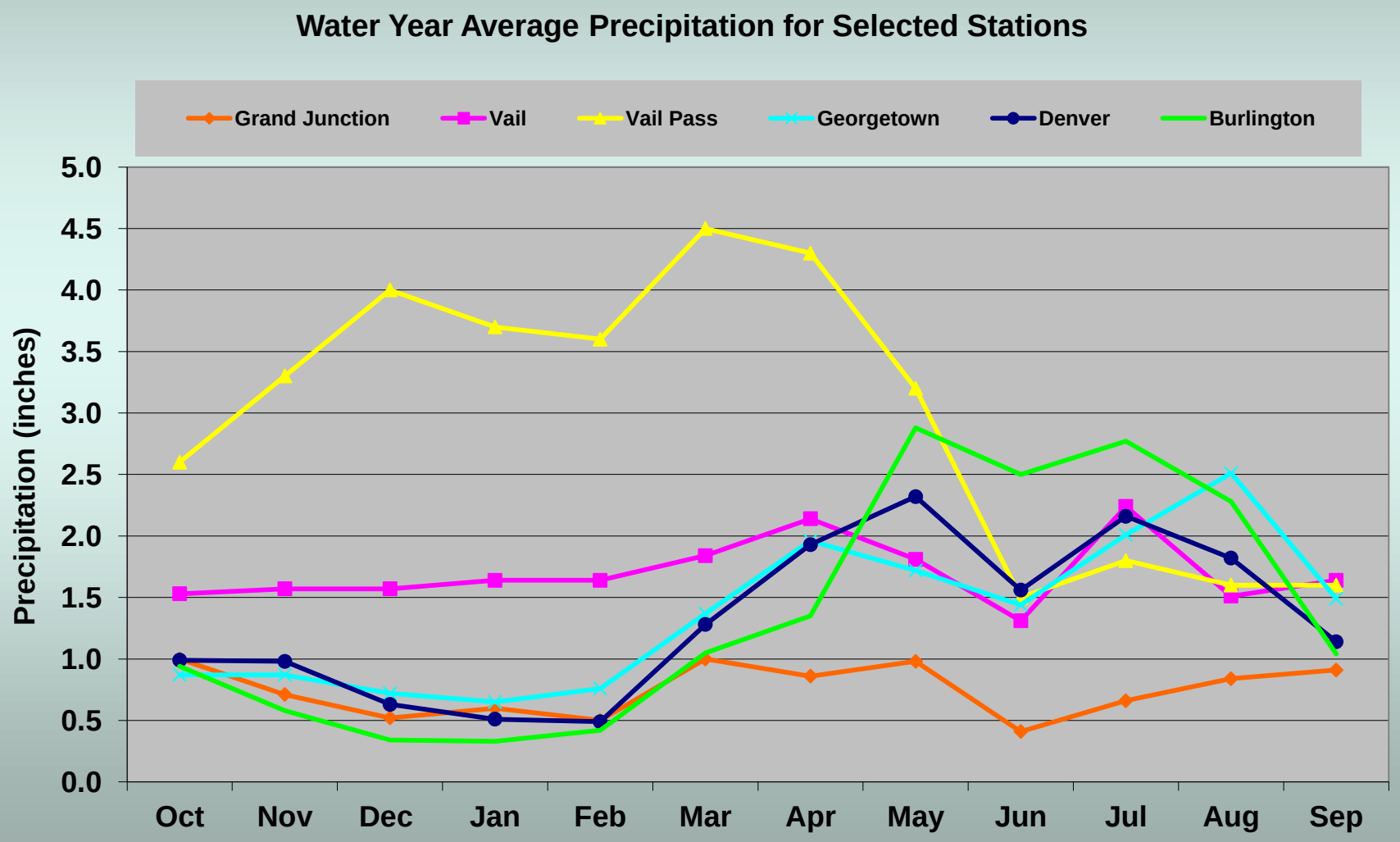
Colorado July 2013 Precipitation as a Percentage of Normal

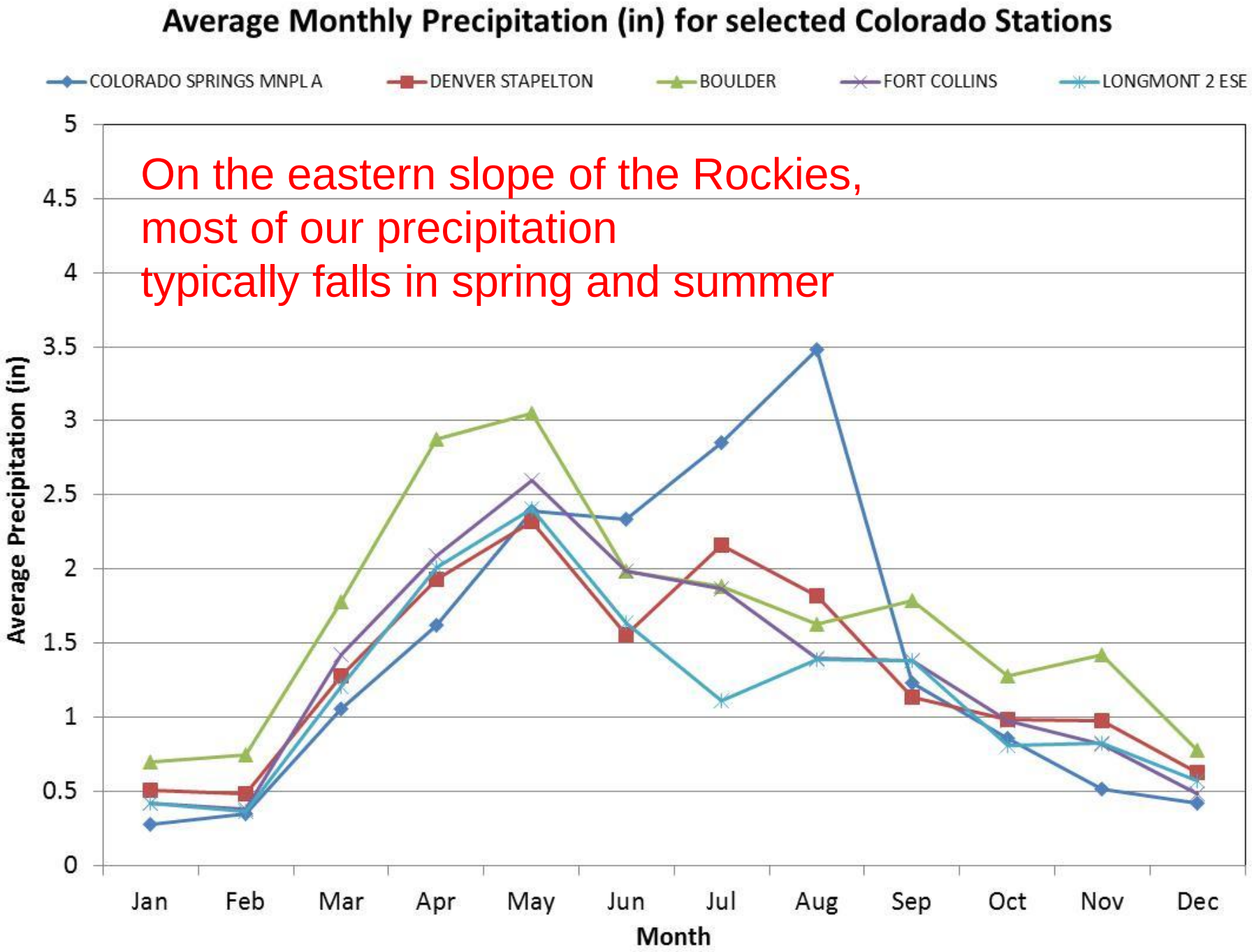


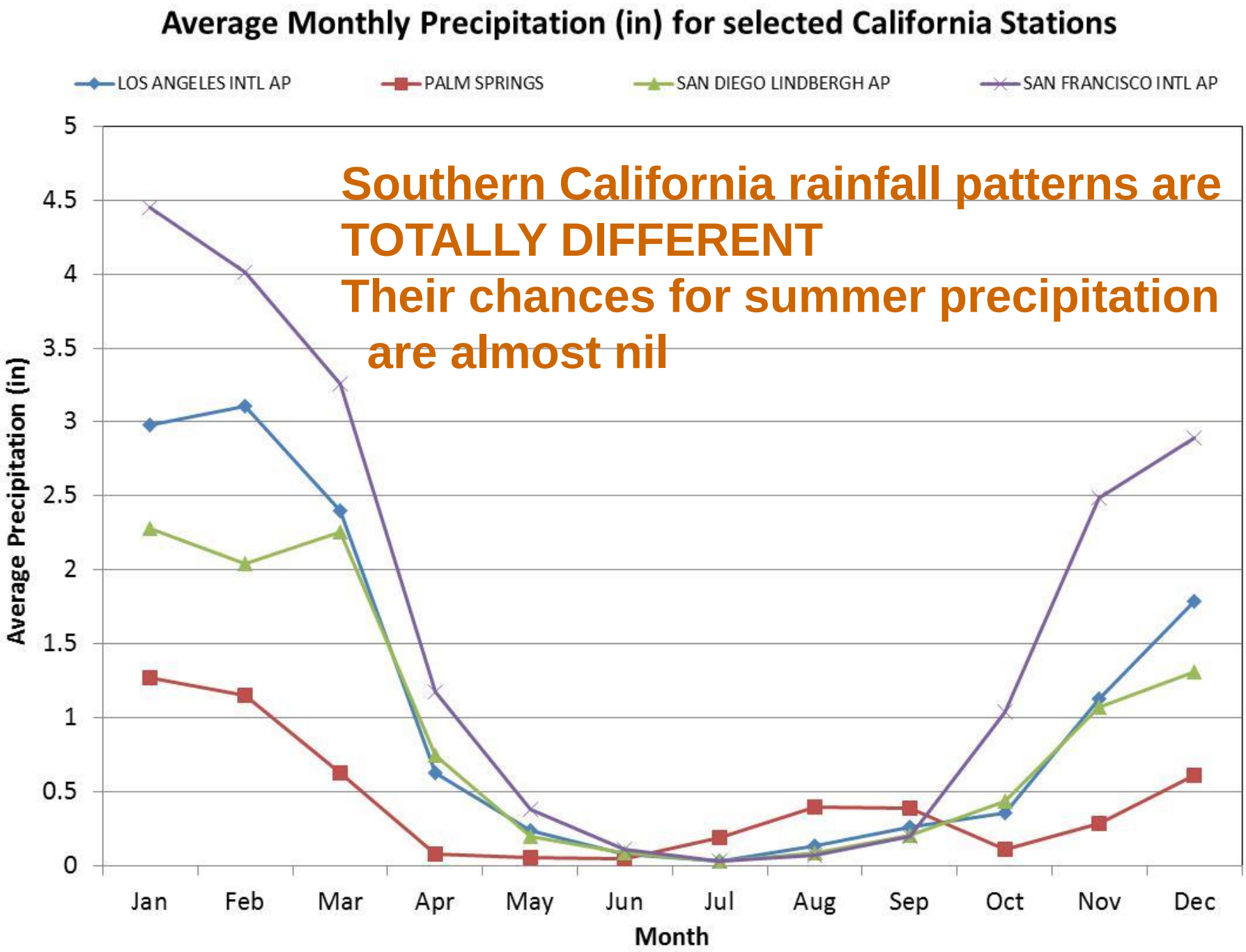
Jul 2013 Percent of Normal



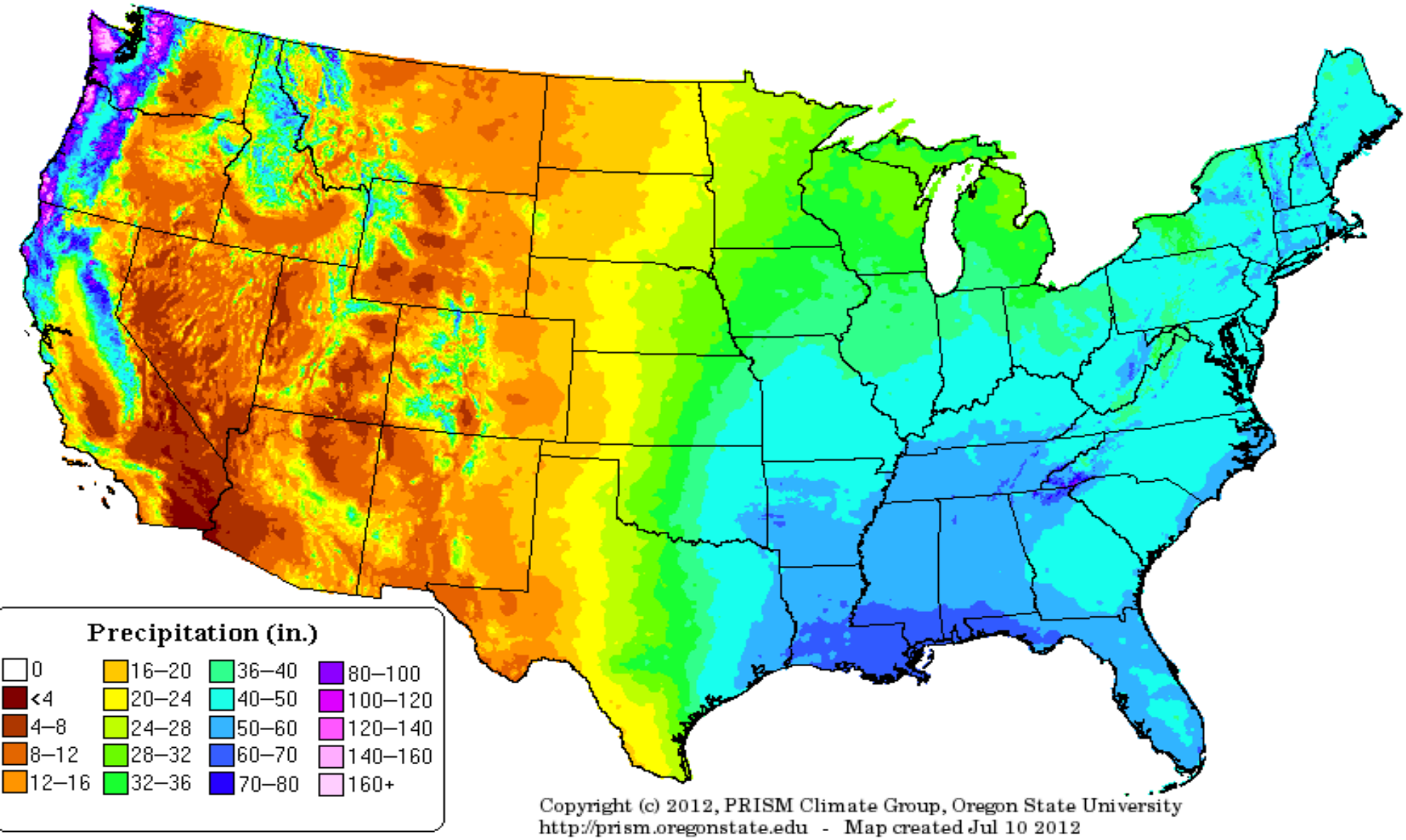
Precipitation in Colorado varies greatly from place to place with changing seasons



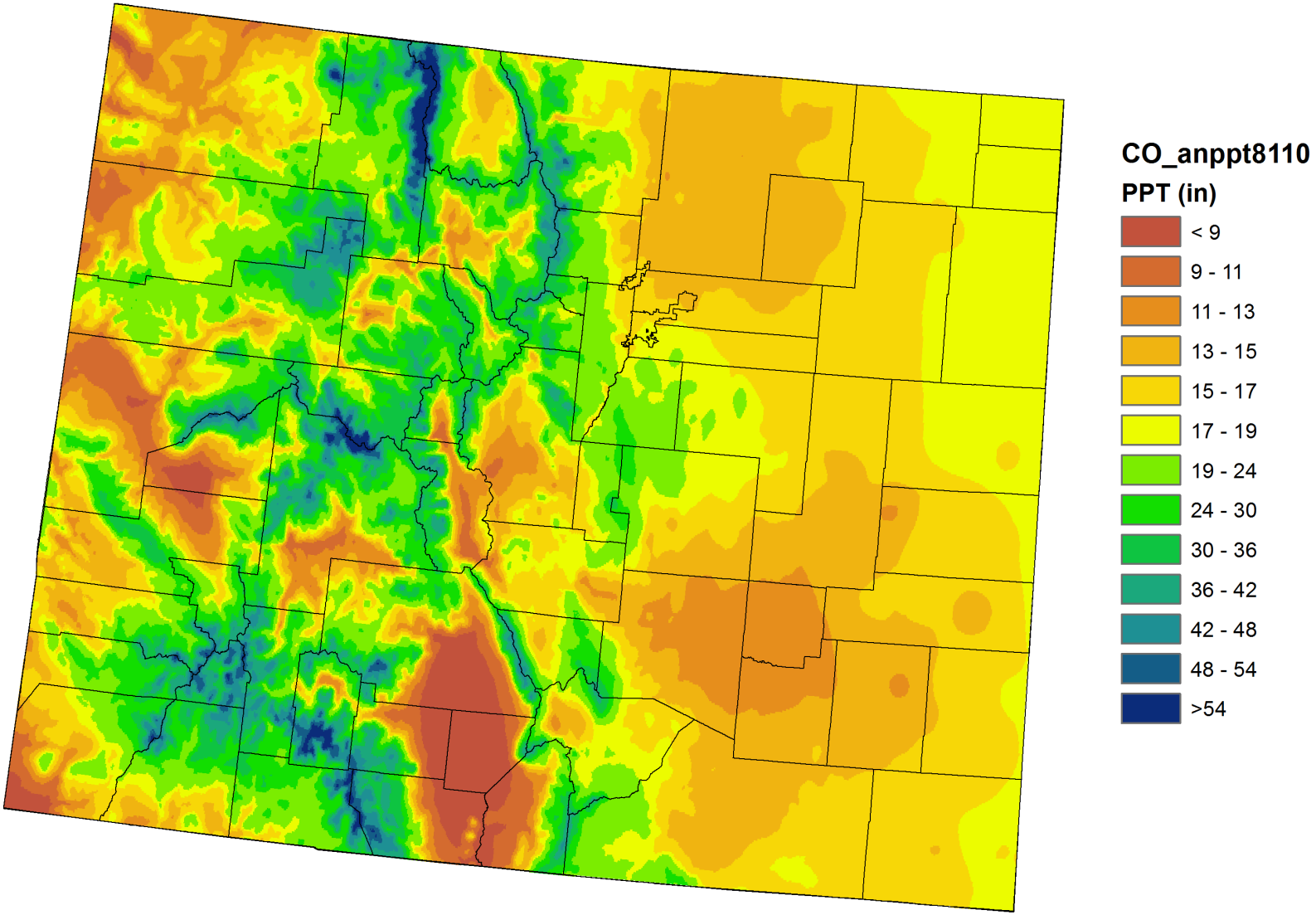

Average Monthly Precipitation (in) for selected Colorado Stations
COLORADO SPRINGS MNPL A
DENVER STAPELTON
BOULDER
FORT COLLINS
LONGMONT 2 ESE
On the eastern slope of the Rockies,
most of our precipitation
typically falls in spring and summer
Average Precipitation (in)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Average Monthly Precipitation (in) for selected California Stations
LOS ANGELES INTL AP
PALM SPRINGS
SAN DIEGO LINDBERGH AP
SAN FRANCISCO INTL AP
Average Precipitation (in)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month
Southern California rainfall patterns are TOTALLY DIFFERENT
Their chances for summer precipitation are almost nil

Precipitation: Annual Climatology (1981-2010)

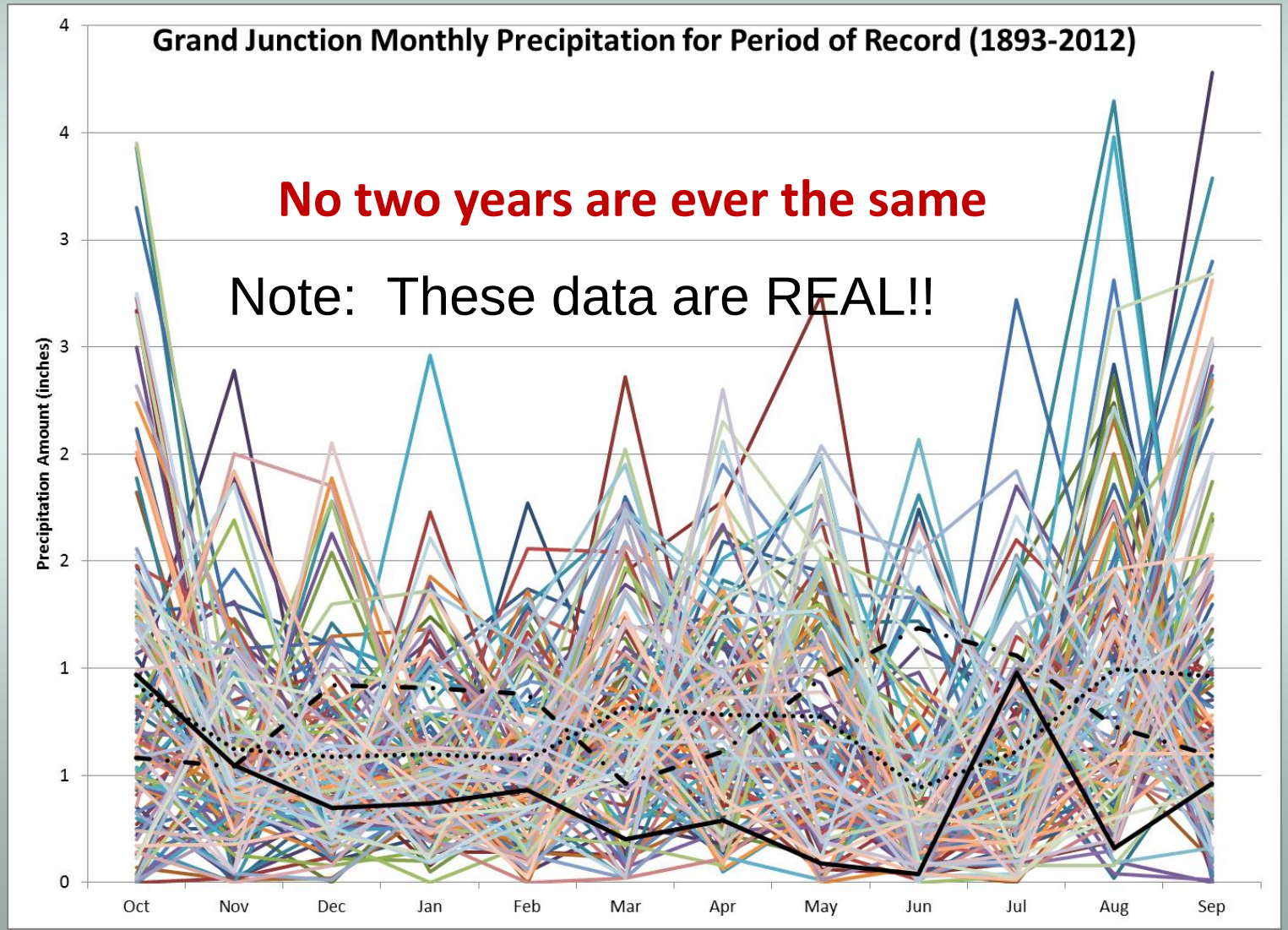


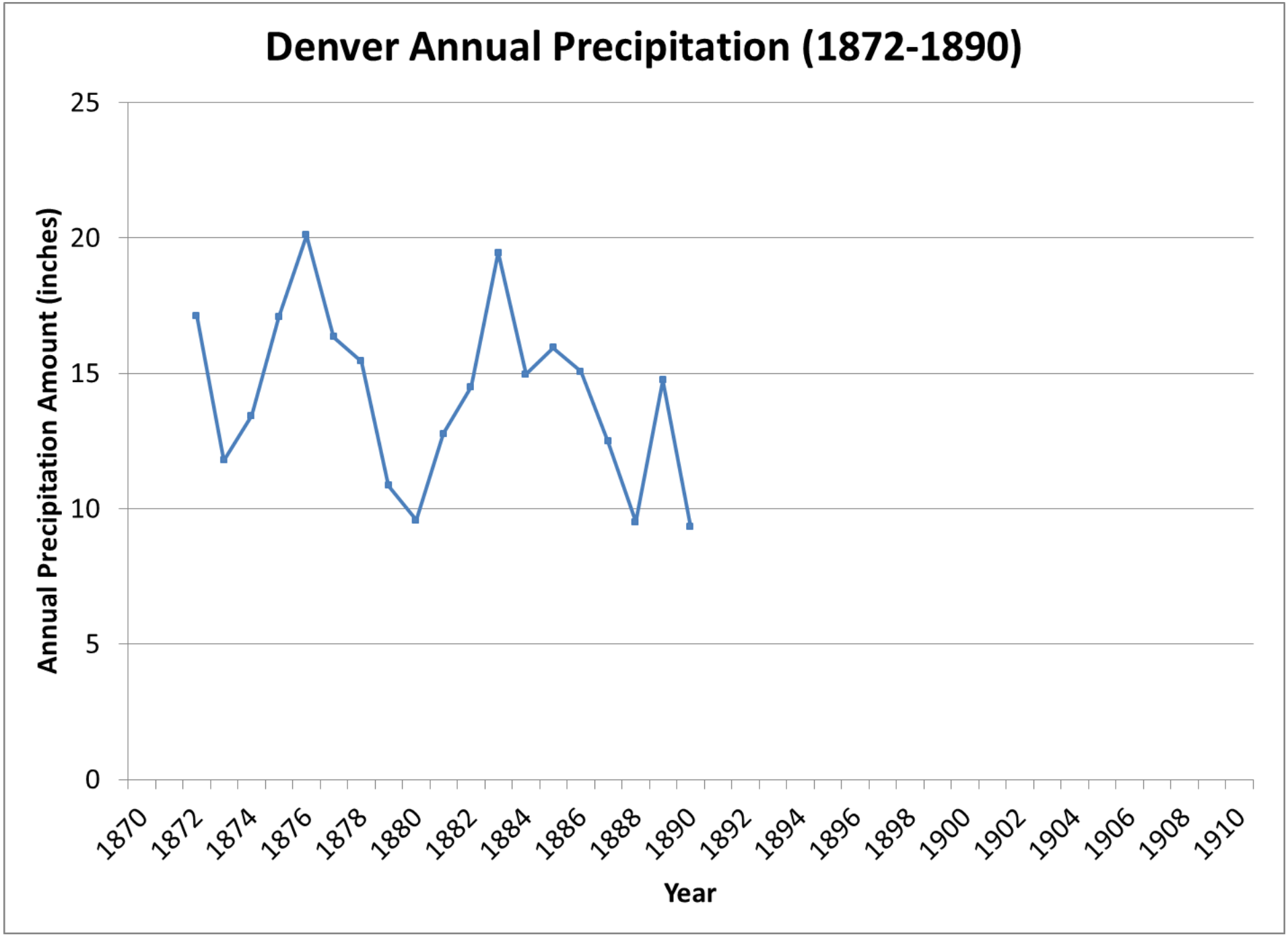
Colorado Annual Average Precipitation (in) 1981-2010

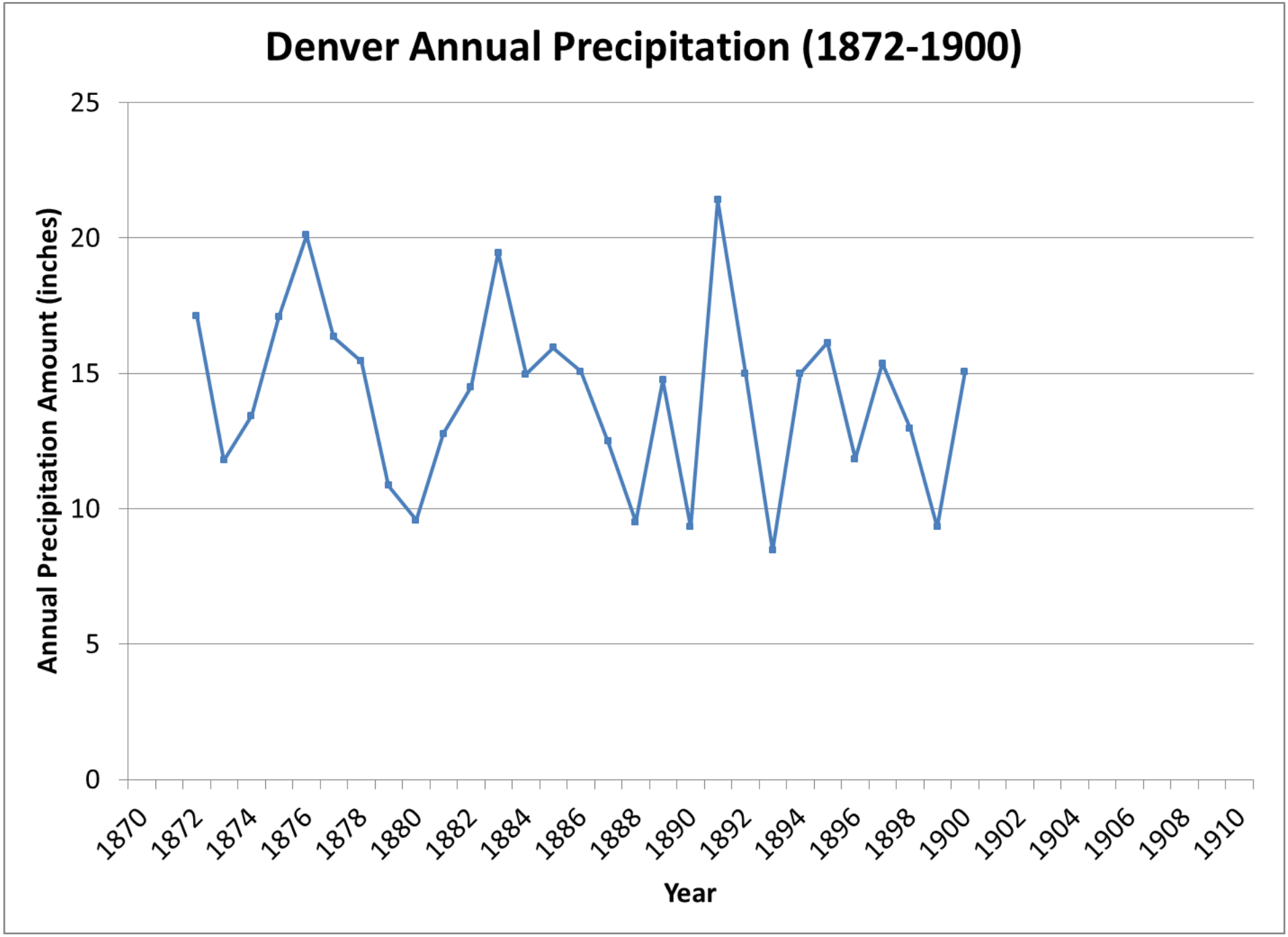


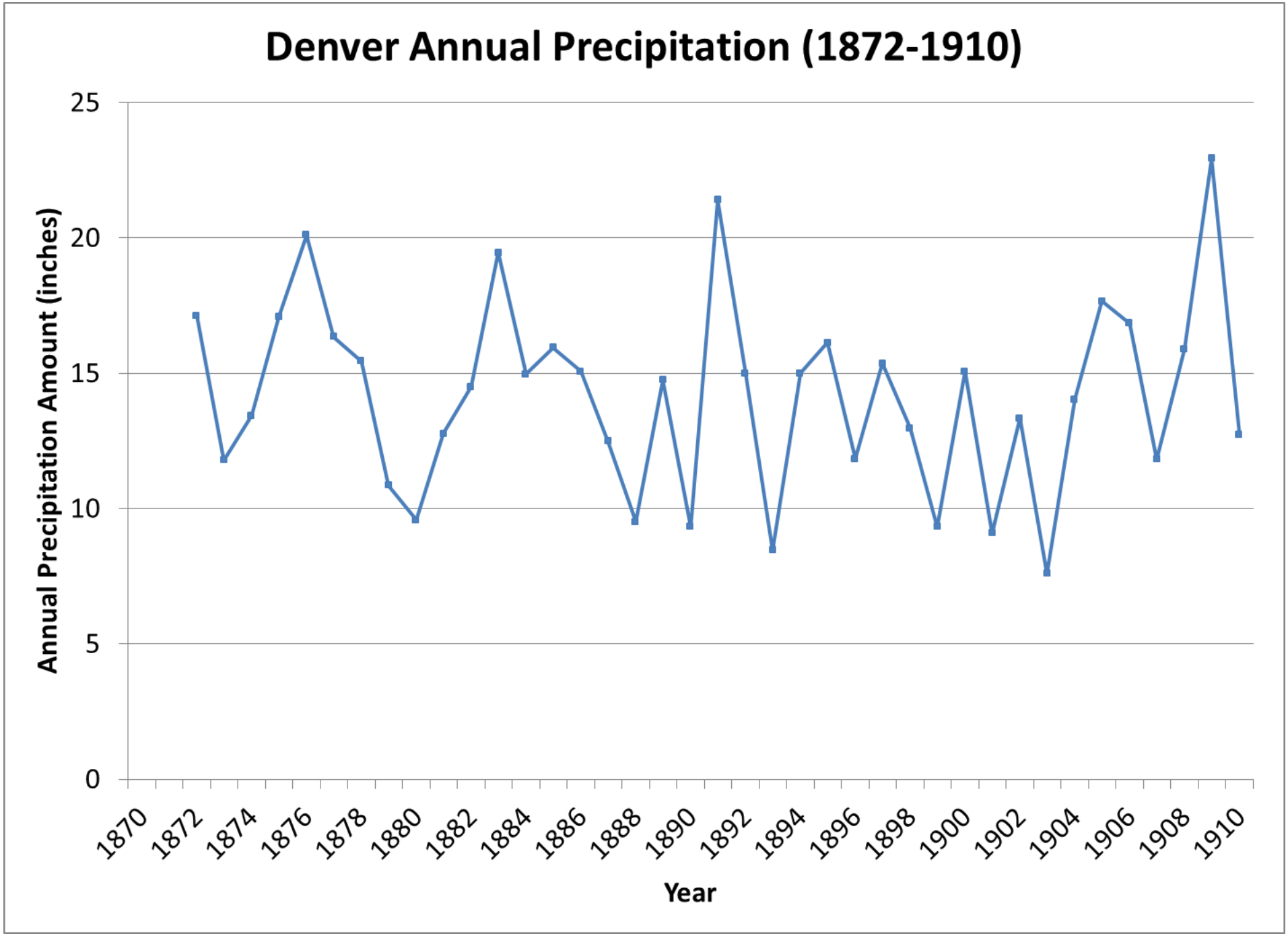
How this compares to our first color contour average precip map from the 1920s

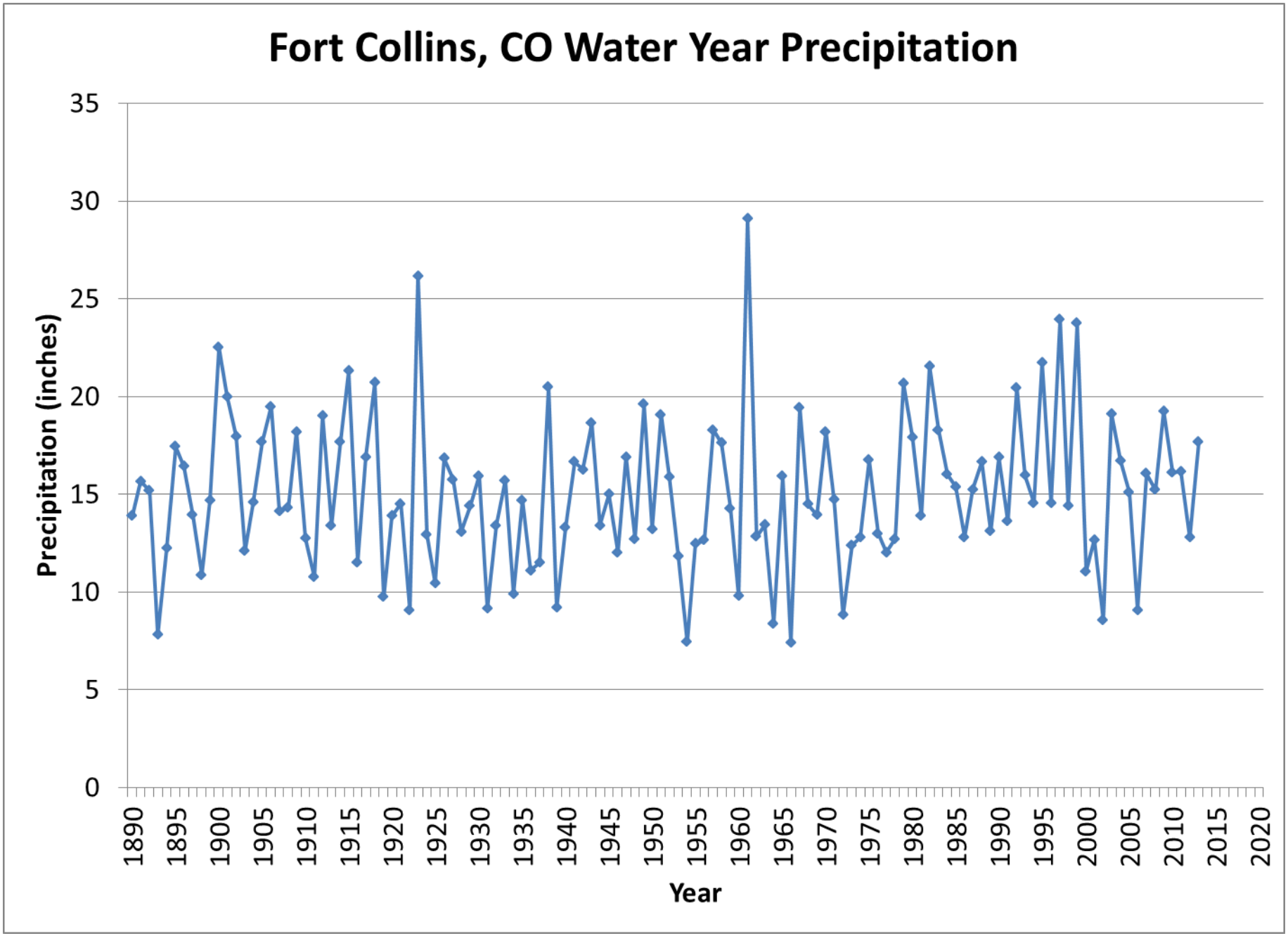
Averages are Useful, But this is what really happens




Denver Annual Precipitation (1872-1890)
Annual Precipitation Amount (inches)
25
20
15
10
5
0
1870
1872
1874
1876
1878
1880
1882
1884
1886
1888
1890
1892
1894
1896
1898
1900
1902
1904
1906
1908
1910
Year

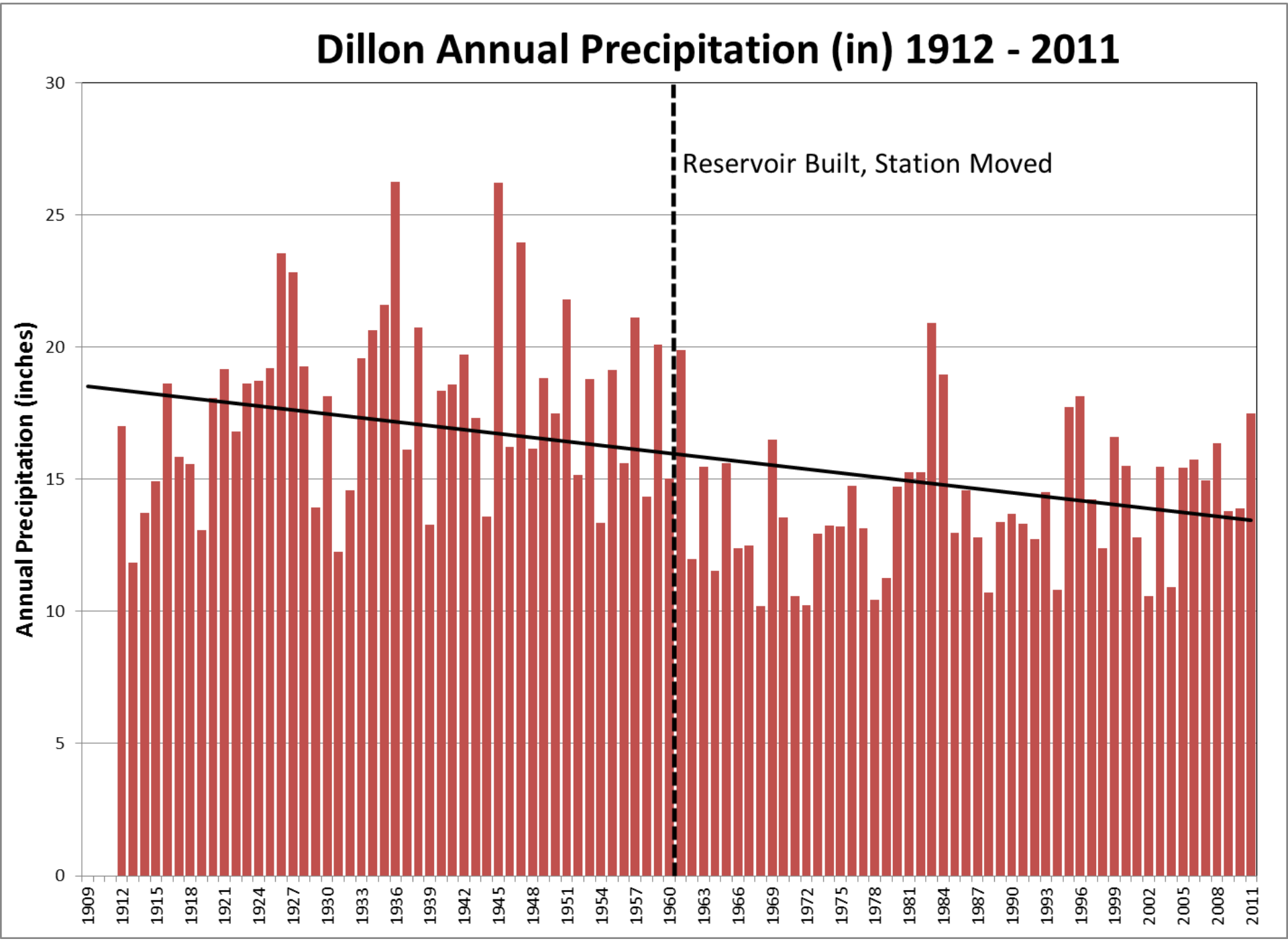

Denver Annual Precipitation (1872-1900)
Annual Precipitation Amount (inches)
25
20
15
10
5
0
1870
1872
1874
1876
1878
1880
1882
1884
1886
1888
1890
1892
1894
1896
1898
1900
1902
1904
1906
1908
1910
Year


Denver Annual Precipitation (1872-1910)
Annual Precipitation Amount (inches)
25
20
15
10
5
0
1870
1872
1874
1876
1878
1880
1882
1884
1886
1888
1890
1892
1894
1896
1898
1900
1902
1904
1906
1908
1910
Year


Fort Collins, CO Water Year Precipitation
Precipitation (inches)
35
30
25
20
15
10
5
0
1890
1895
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Year

Time series are not always as they appear

Always need to dig deeper

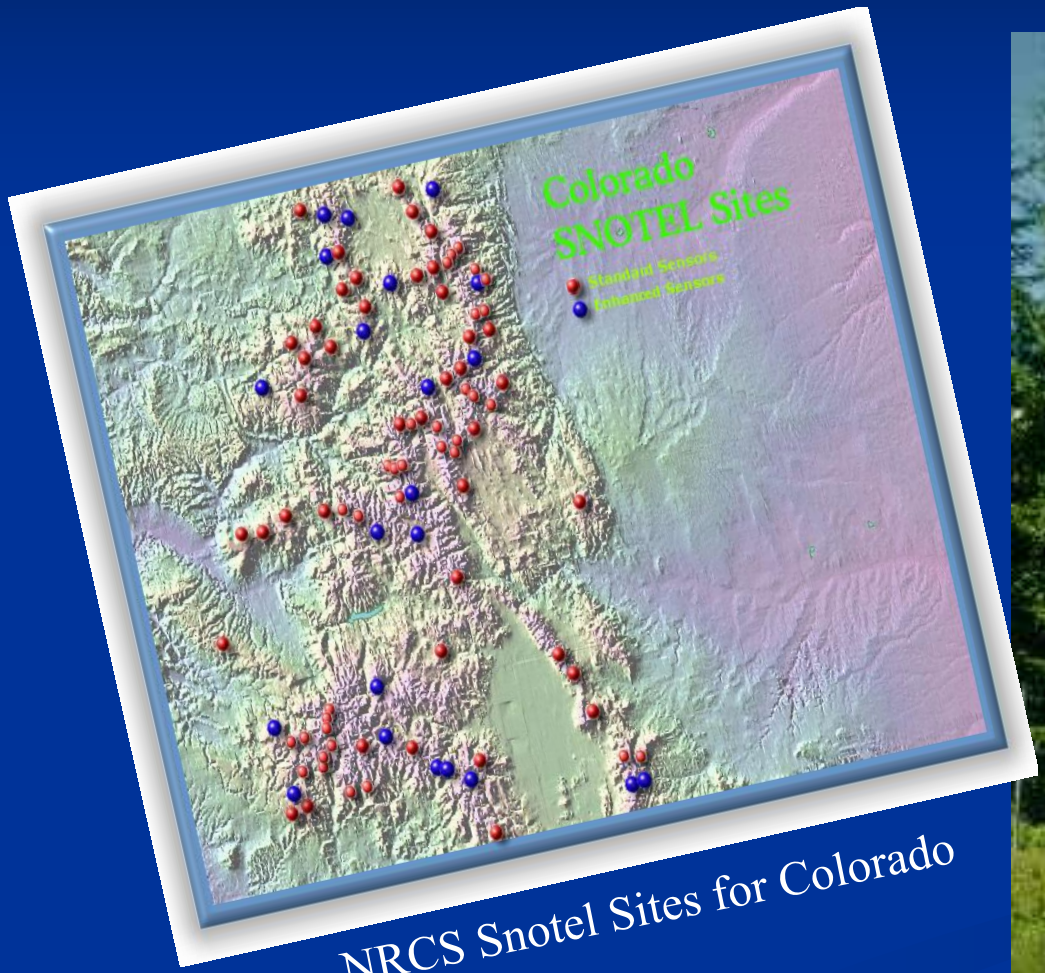

Dillon Annual Precipitation (in) 1912 - 2011
Reservoir Built, Station Moved
Annual Precipitation (inches)
30
25
20
15
10
5
0
1909
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011

Reality -- Most Surface Water Supplies in the West Come From Mountain Snowmelt

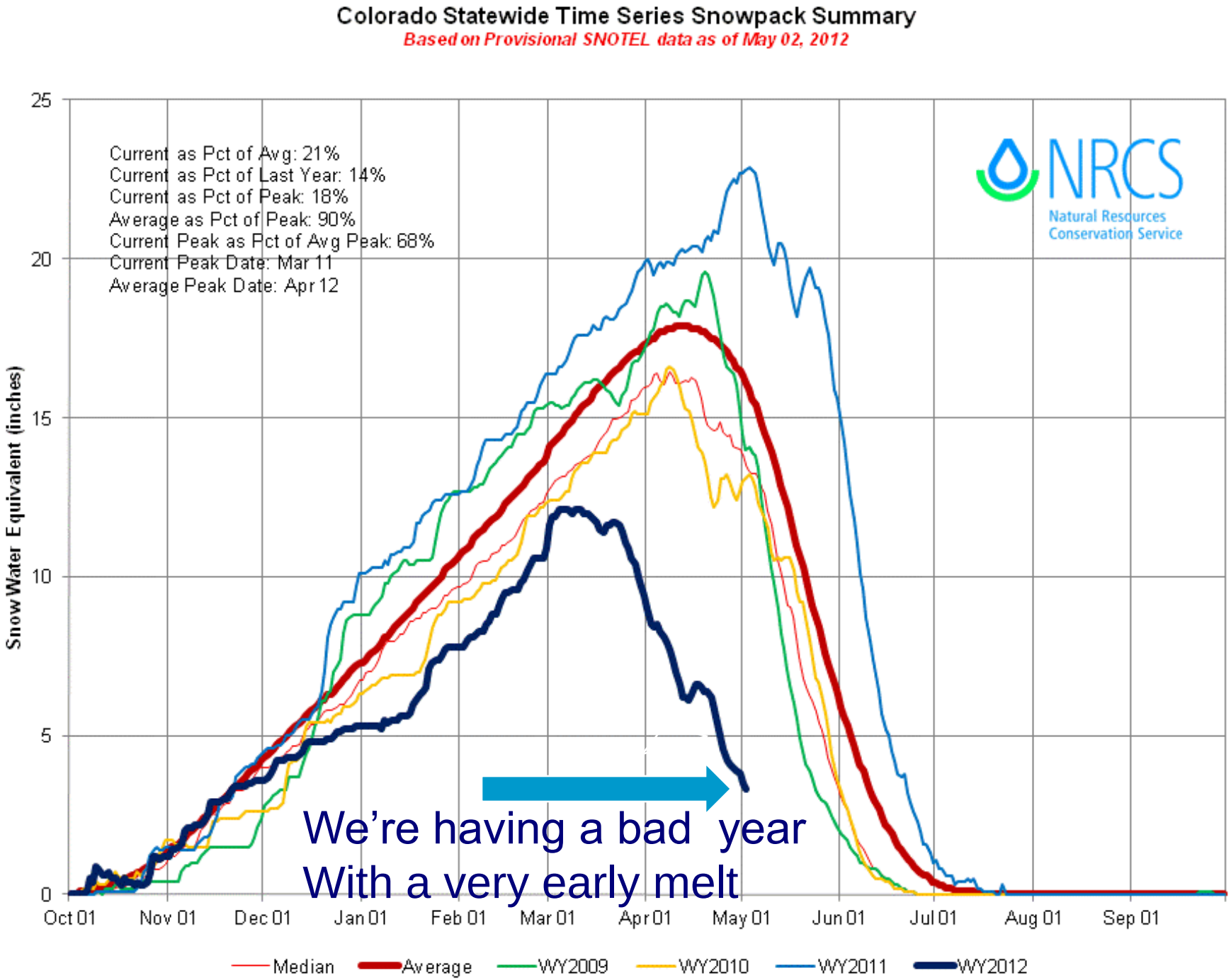
Snow surveys began in the 1930s

And Continue today -- reluctantly

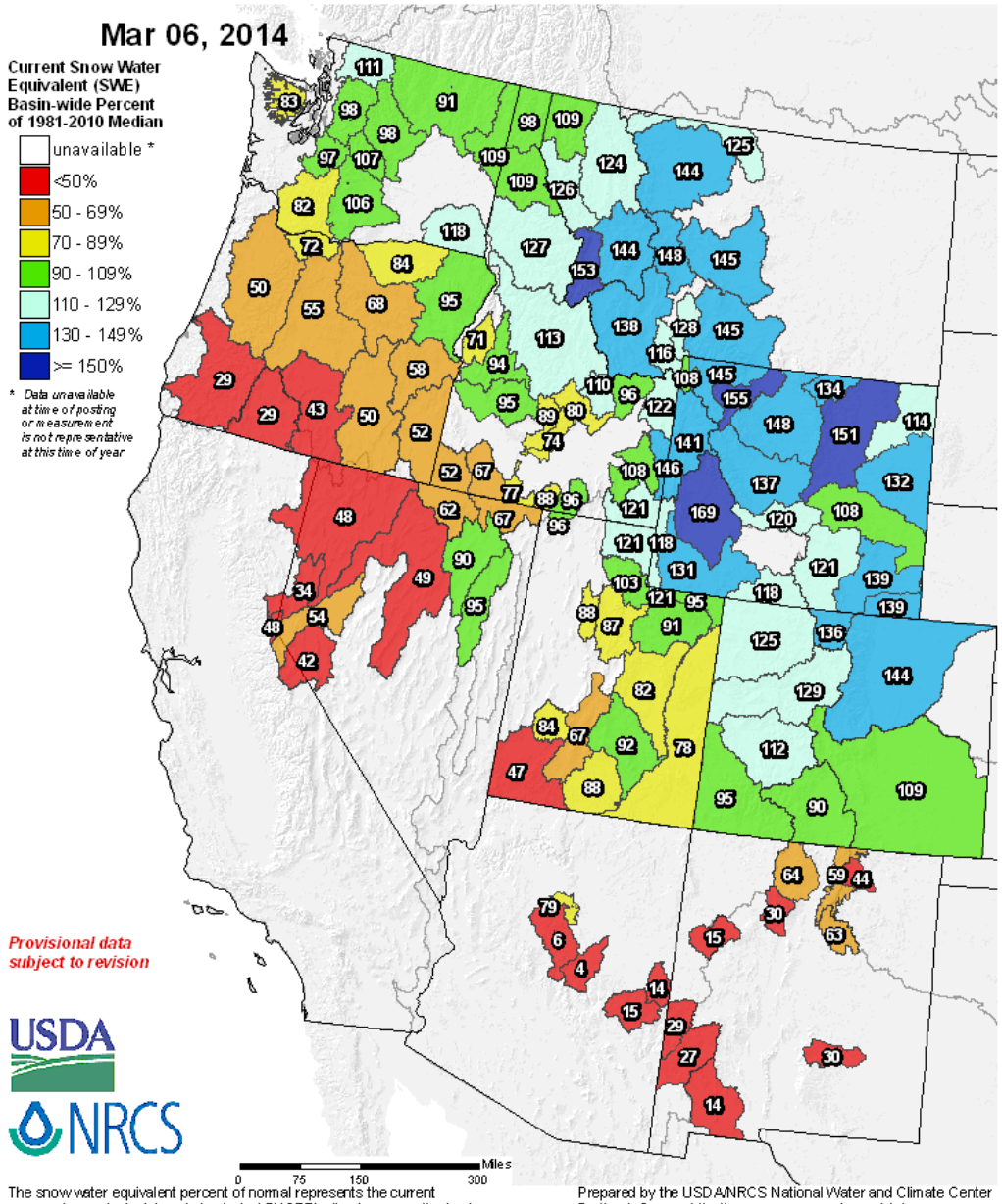
USDA, Natural Resources Conservation Service -- "SNOTEL Rules" but is it sufficient?



NRCS Snotel Sites for Colorado


Colorado Statewide Time Series Snowpack Summary
Based on Provisional SNOTEL data as of May 02, 2012
Current as Pct of Avg: 21%
Current as Pct of Last Year: 14%
Current as Pct of Peak: 18%
Average as Pct of Peak: 90%
Current Peak as Pct of Avg Peak: 68%
Current Peak Date: Mar 11
Average Peak Date: Apr 12
NRCS
Natural Resources Conservation Service
Snow Water Equivalent (inches)
25
20
15
10
5
0
Oct 01
Nov 01
Dec 01
Jan 01
Feb 01
Mar 01
Apr 01
May 01
Jun 01
Jul 01
Aug 01
Sep 01
We're having a bad year
With a very early melt
Median
Average
WY2009
WY2010
WY2011
WY2012

Westwide SNOTEL Current Snow Water Equivalent (SWE) % of Normal



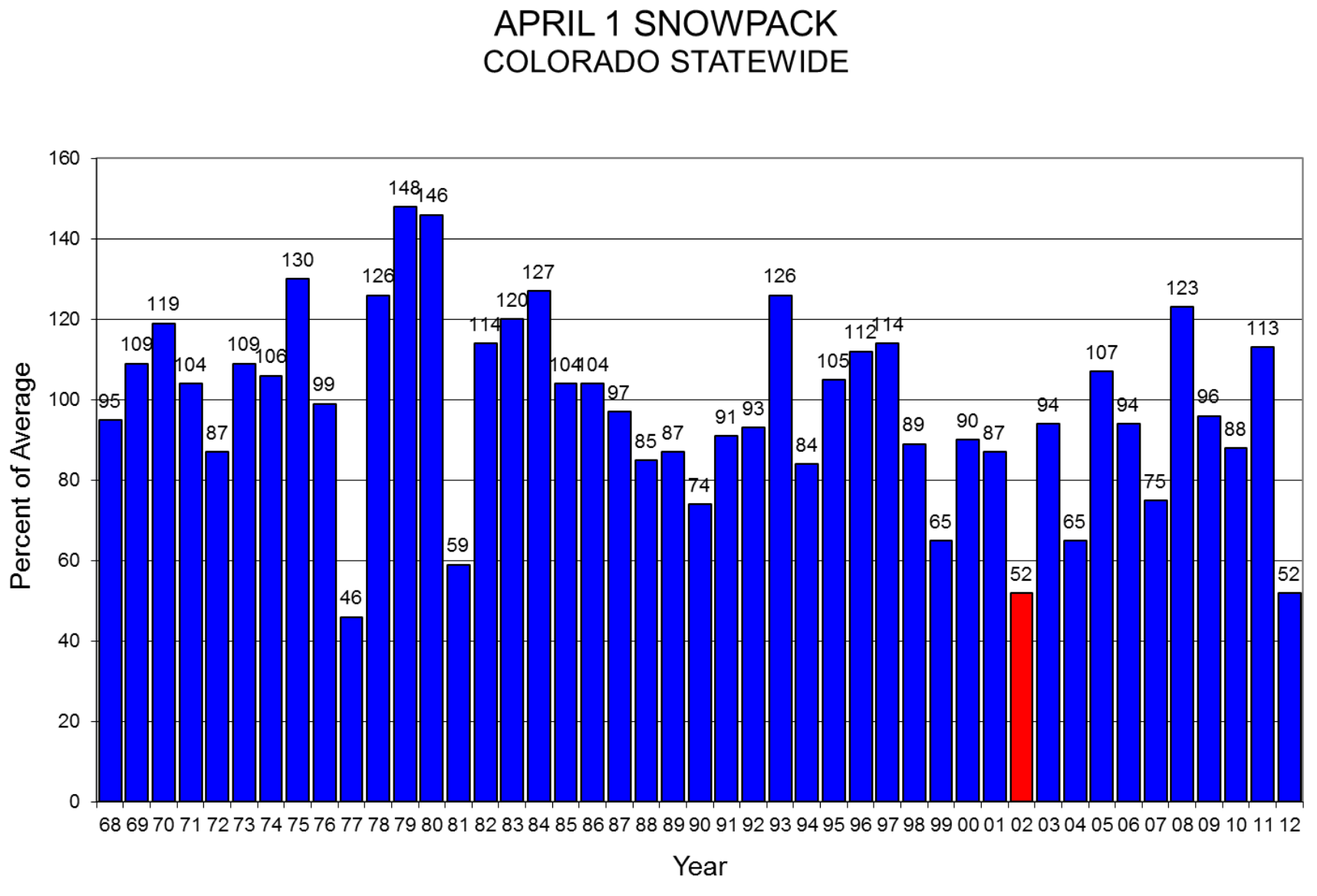
The snow water equivalent percent of normal represents the current snowwater equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

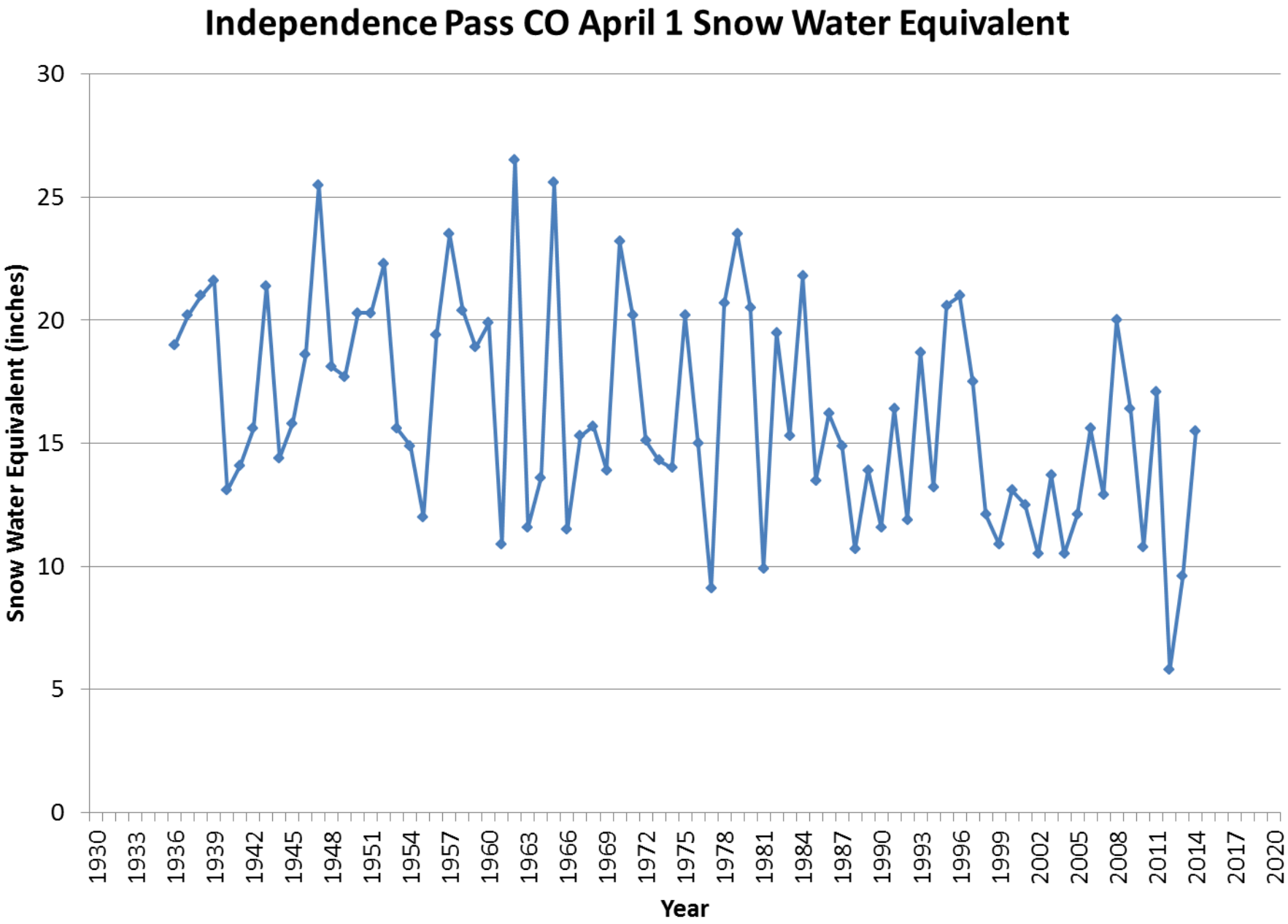
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

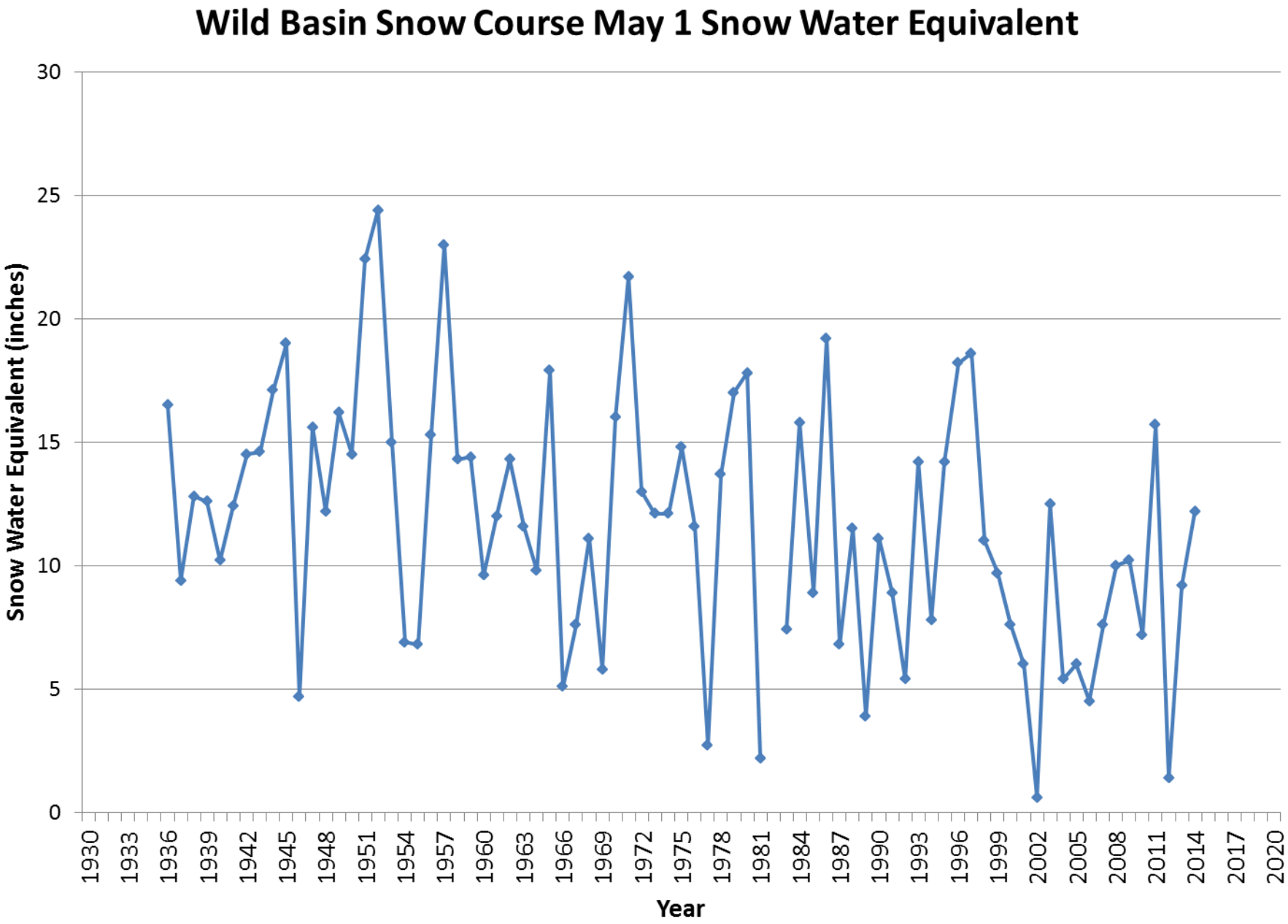
- Snow Surveys were initiated and are maintained to help forecast water supplies
- Now they are being used to track changes in the climate
- Are they up to this task?

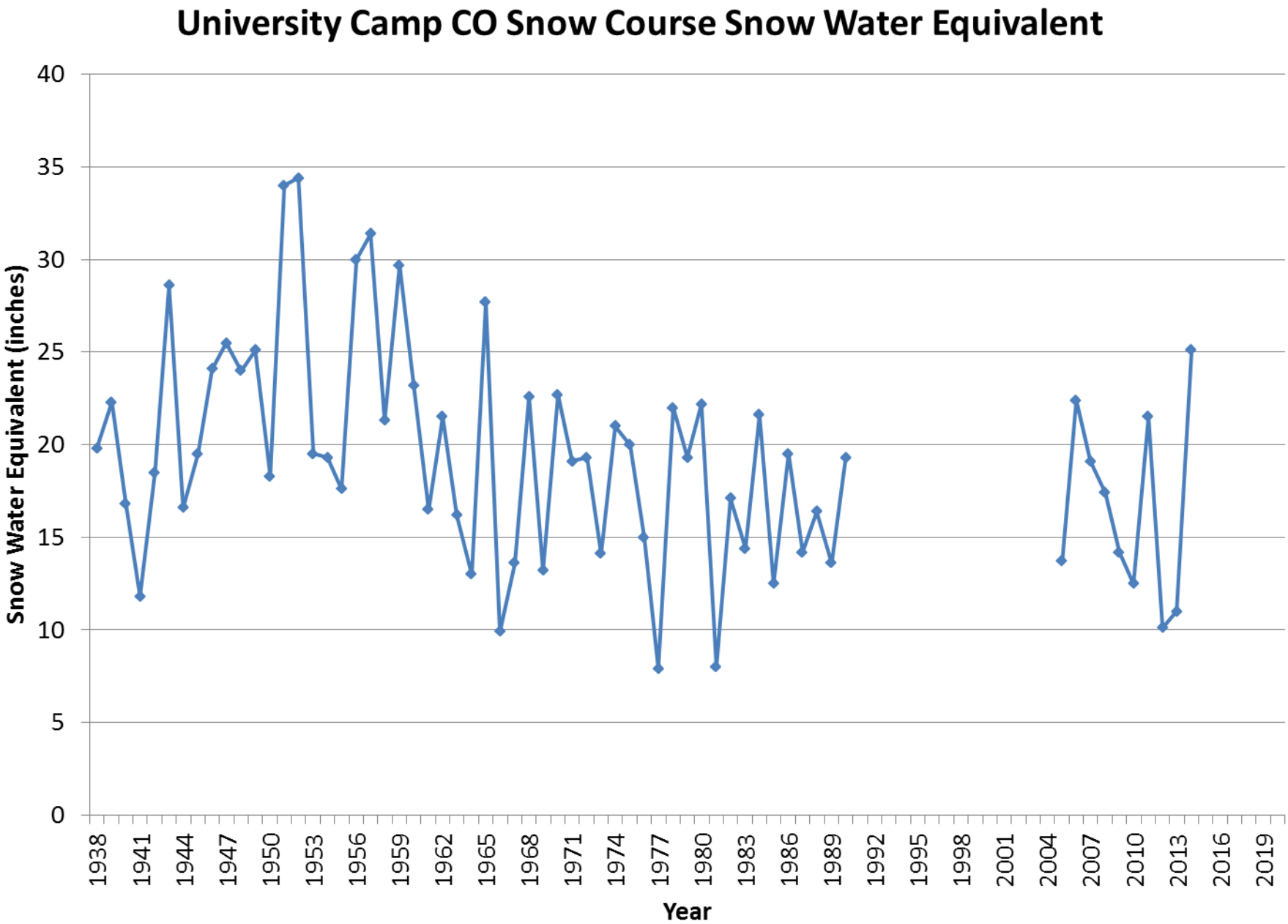
Colorado Statewide April 1 Snowpack

Time Series of April 1 Snowpack – Tracking Variability and Trends




Independence Pass CO April 1 Snow Water Equivalent
Snow Water Equivalent (inches)
30
25
20
15
10
5
0
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020
Year


Wild Basin Snow Course May 1 Snow Water Equivalent
Snow Water Equivalent (inches)
30
25
20
15
10
5
0
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020
Year

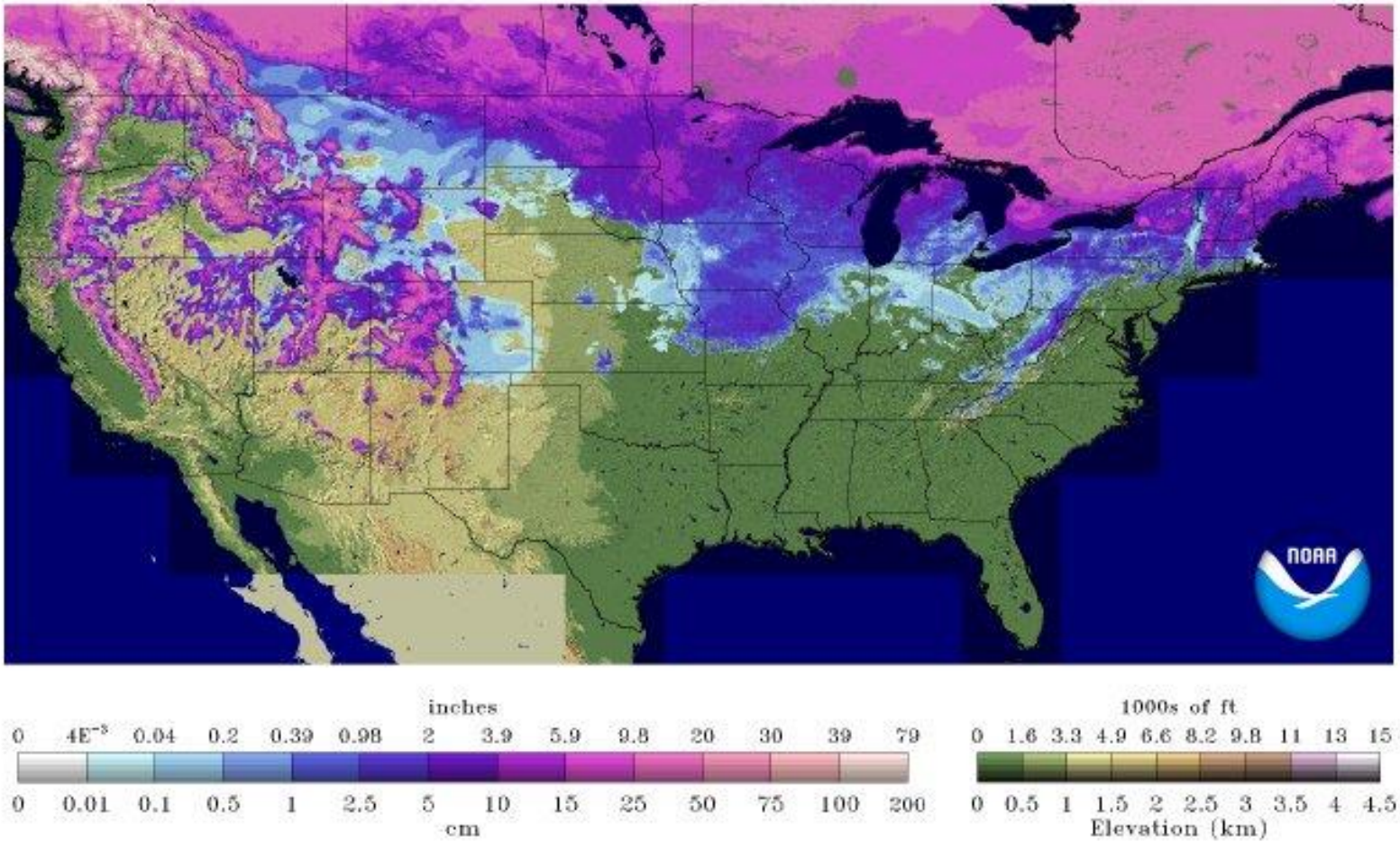

University Camp CO Snow Course Snow Water Equivalent
Snow Water Equivalent (inches)
0
5
10
15
20
25
30
35
40
1938
1941
1944
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016
2019
Year

Taking Point data a step further

NATIONAL SNOW ANALYSIS 2012-2013

Snow Water Equivalent

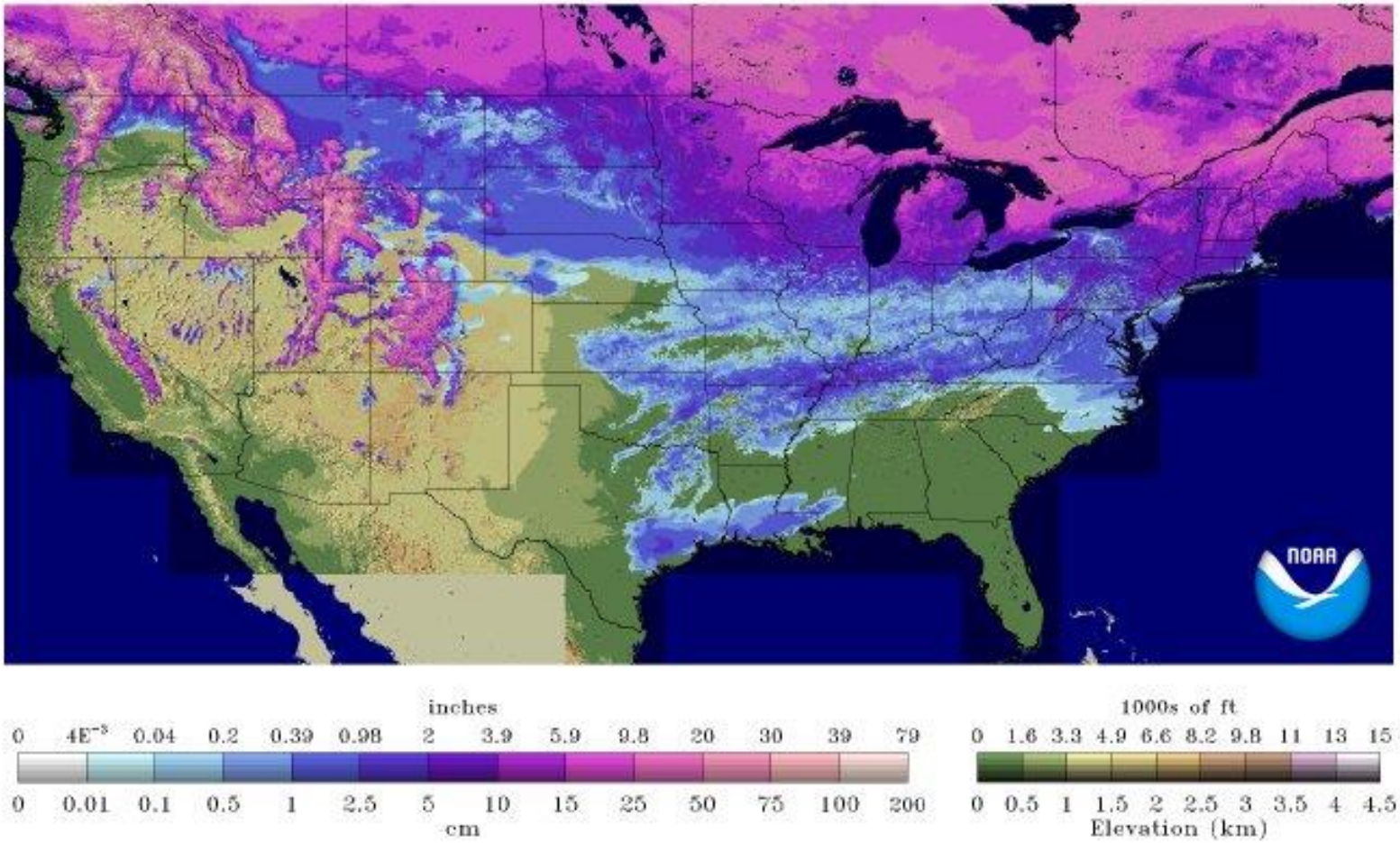
2013-03-05 06



National Snow 2013-2014 Analysis

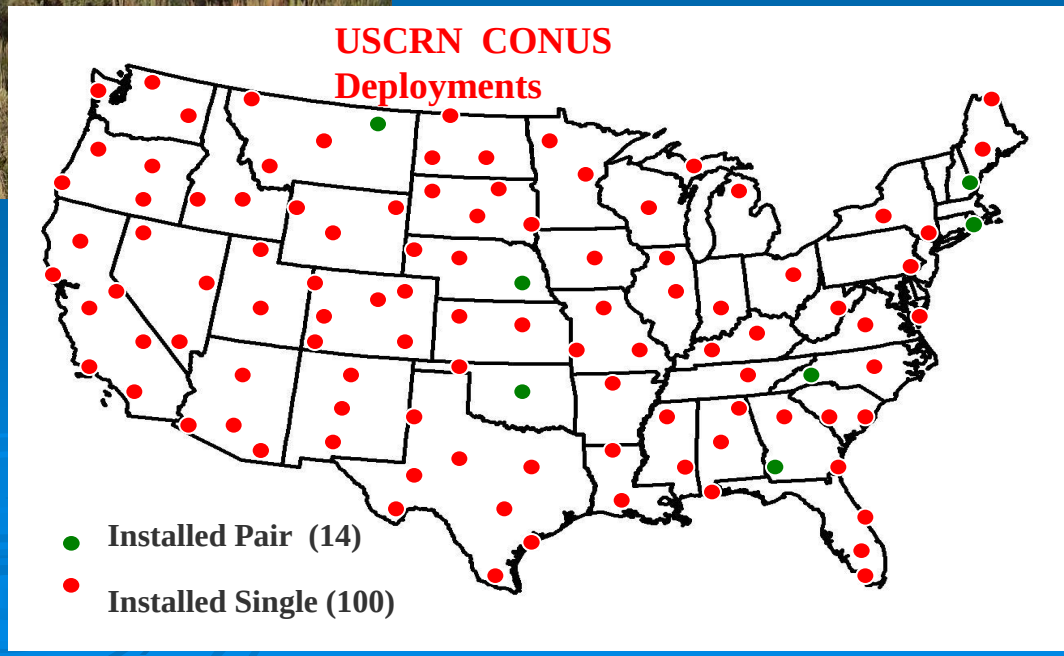
Snow Water Equivalent

2014-03-05 06 UTC

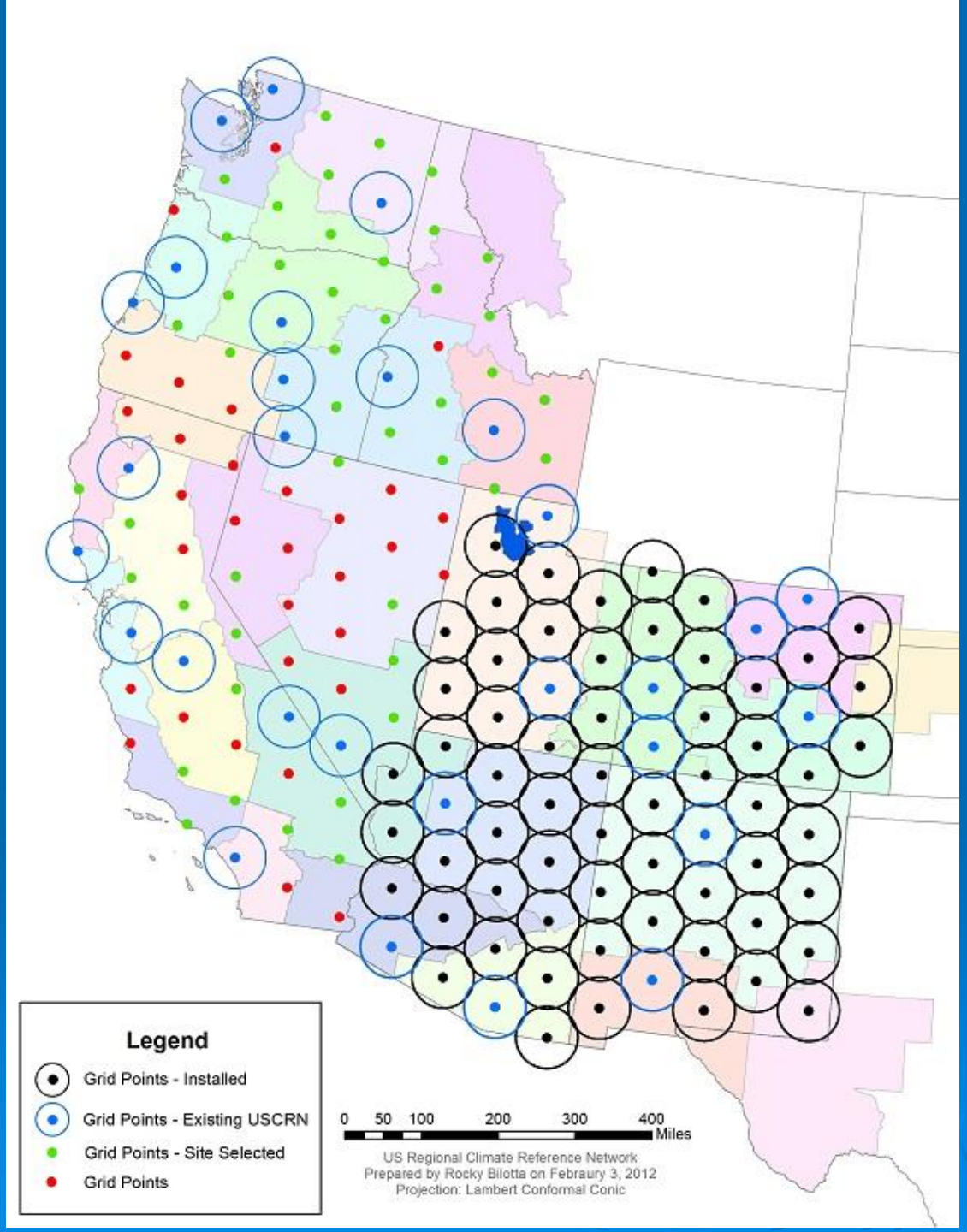


U.S. Climate Reference Network (CRN)

- Since the early 2000s, special observing networks have been added specifically to help track national climate trends



But CRN does not Specifically measure Snow! ☹



Did you know we (NOAA - NWS) also had another similar network?

The “Regional Climate Reference Network”

It was closed effective 1 June 2014

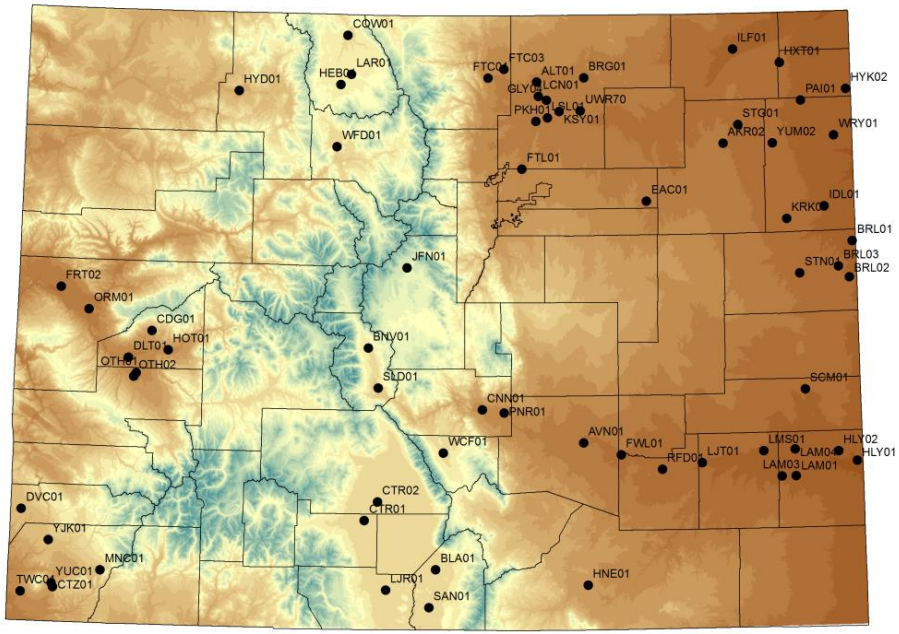
SW states are scrambling to take it over

Many states, like Colorado, have not only taken over many federal streamgauges, but also other basic weather and climate observations – not because we necessarily want to but because we need the information badly.

Many other sources of weather data have been added since the 1970s

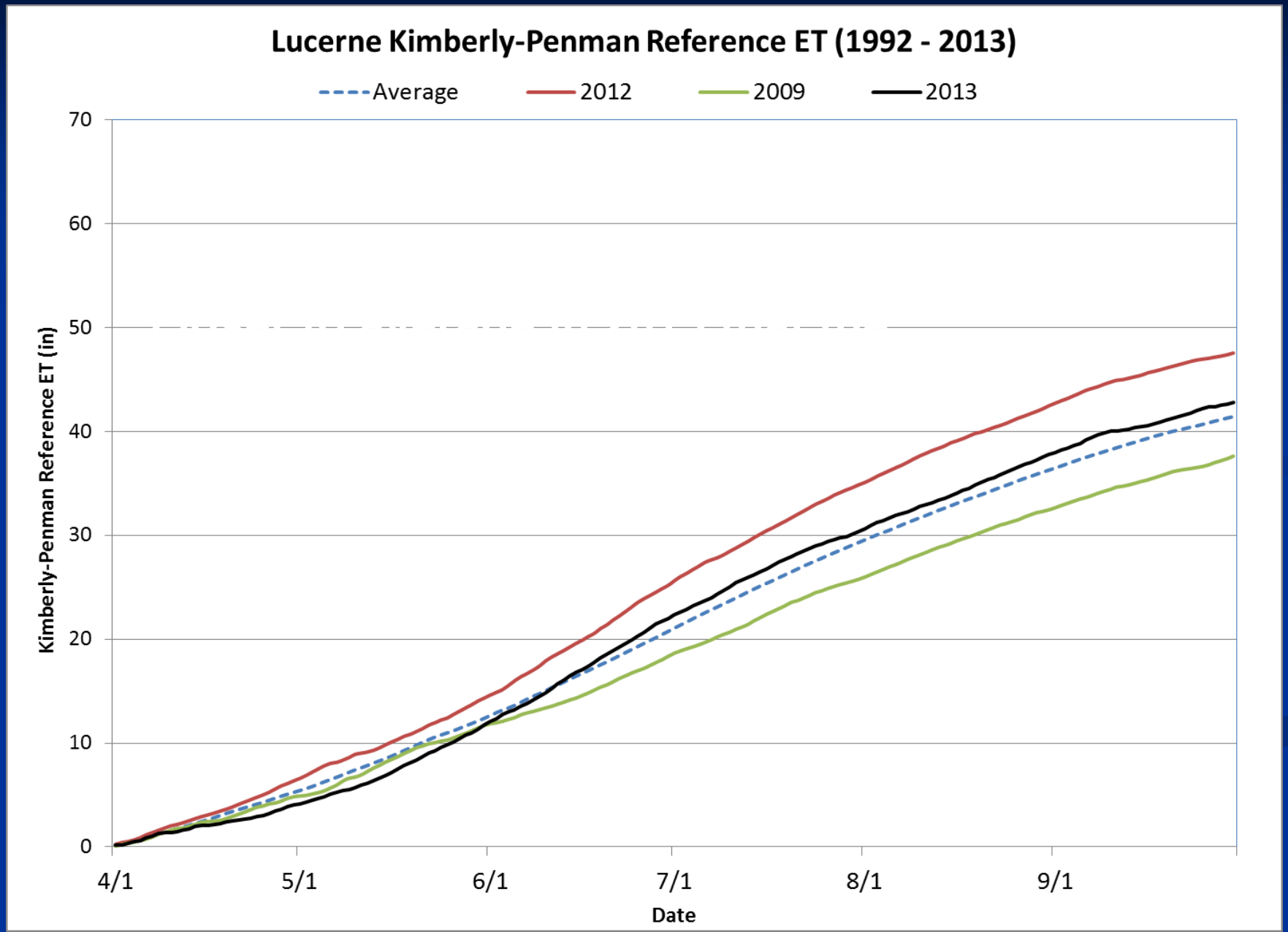
CSU's **Colorado Agricultural Meteorological Network "CoAgMet"**

Current CoAgMet Station Locations - July 2012



THANKS!! to those of You who help support CoAgMet

Lucerne Reference ET



And all the others collecting weather and climate data





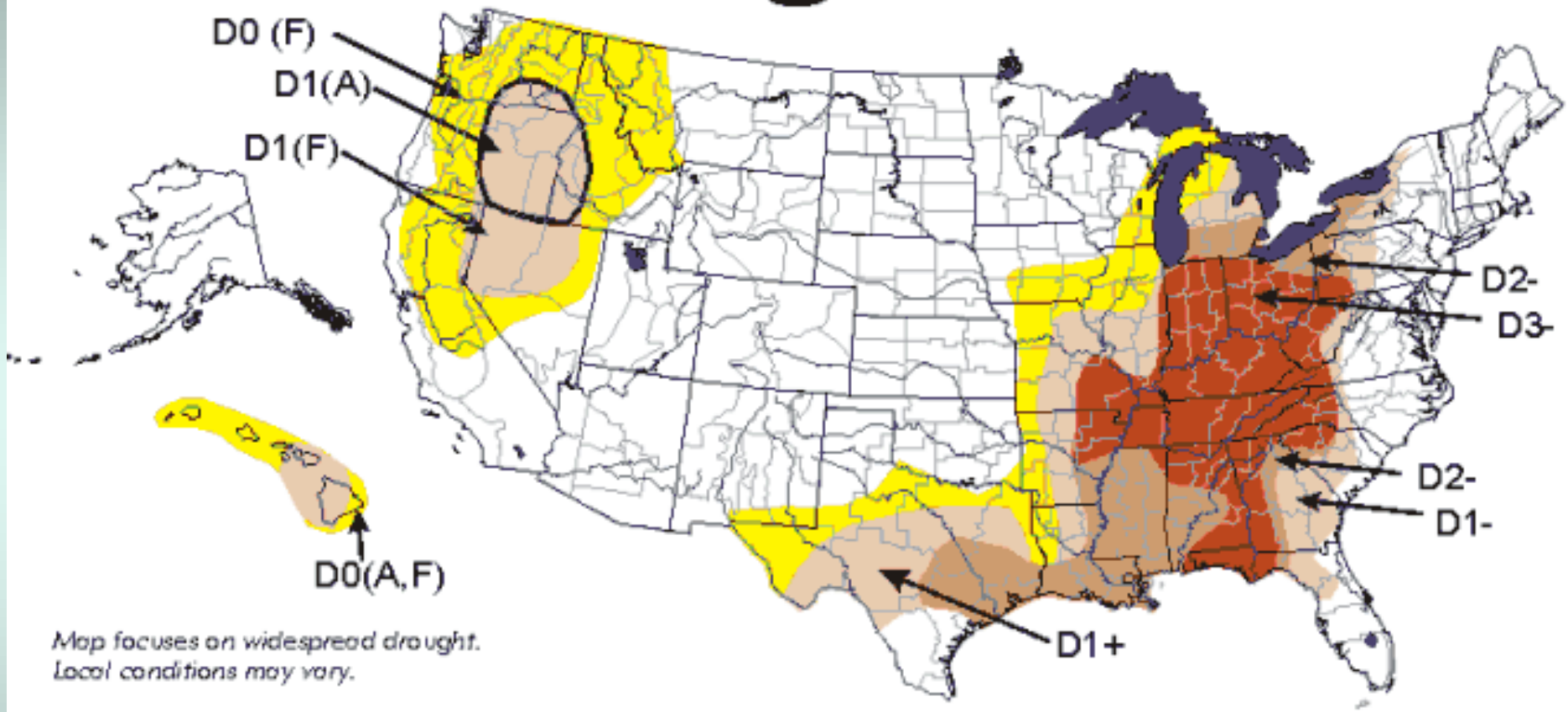

Recent Extreme Drought in SE Colorado

Measuring what "didn't fall" is just as important as measuring what did

Photo by Lyric Lucero
2013 Manzanola, CO

September 28, 1999

U.S. Drought Monitor



Map focuses on widespread drought.
Local conditions may vary.

- D0 Watch
- D1 Drought
- D2 Drought–Severe
- D3 Drought–Extreme
- D4 Drought–Exceptional
- Delineates Overlapping Areas

Drought type: used only when impacts differ

A = Agriculture
W = Water
F = Forest fire danger

Plus (+) = Forecast to intensify next two weeks
Minus (-) = Forecast to diminish next two weeks
No sign = No change in drought classification forecast

USDA

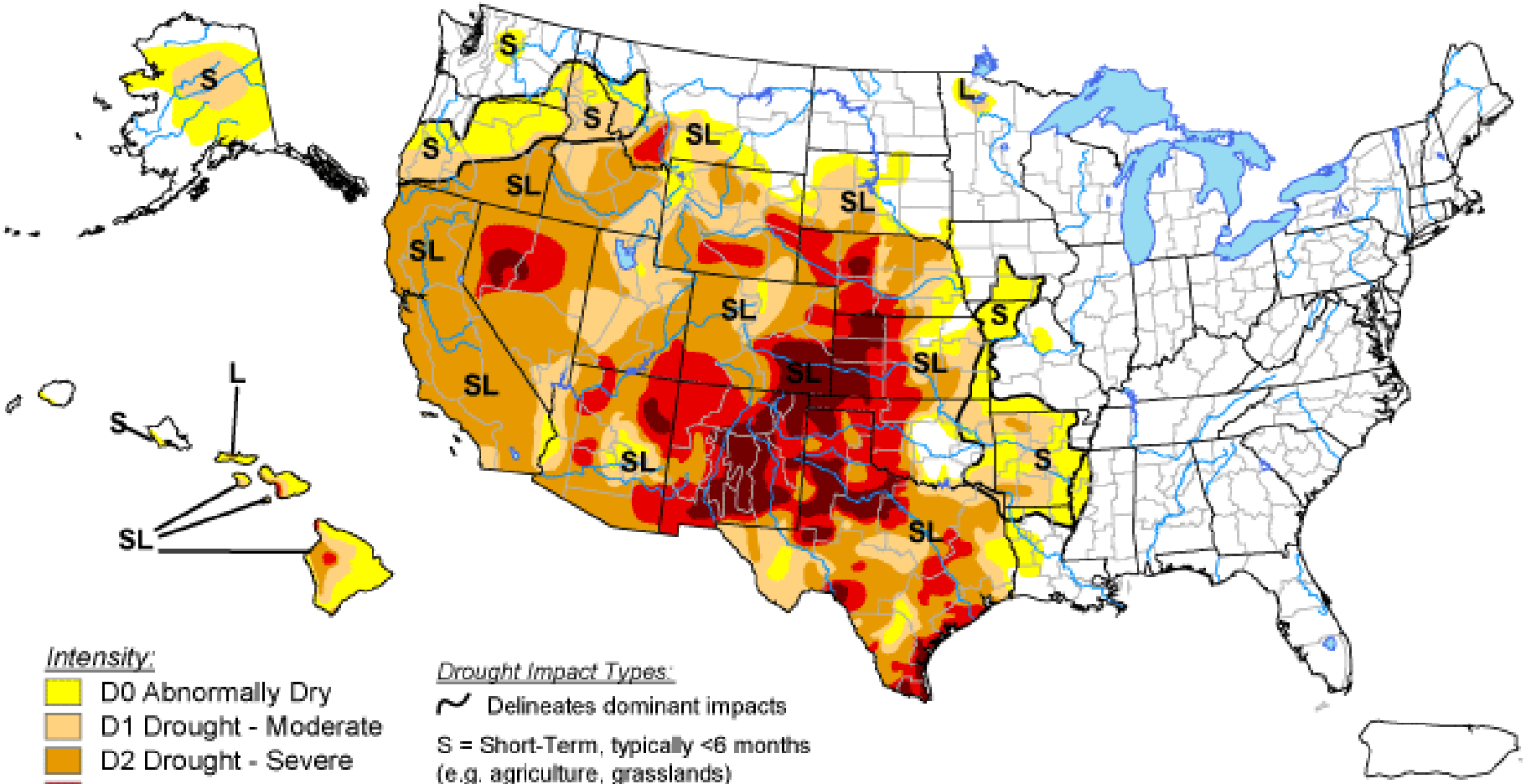
National Drought Mitigation Center

NOAA

• ***Released Thursday, Sep 30, 1999*** •

U.S. Drought Monitor

July 16, 2013
Valid 7 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)

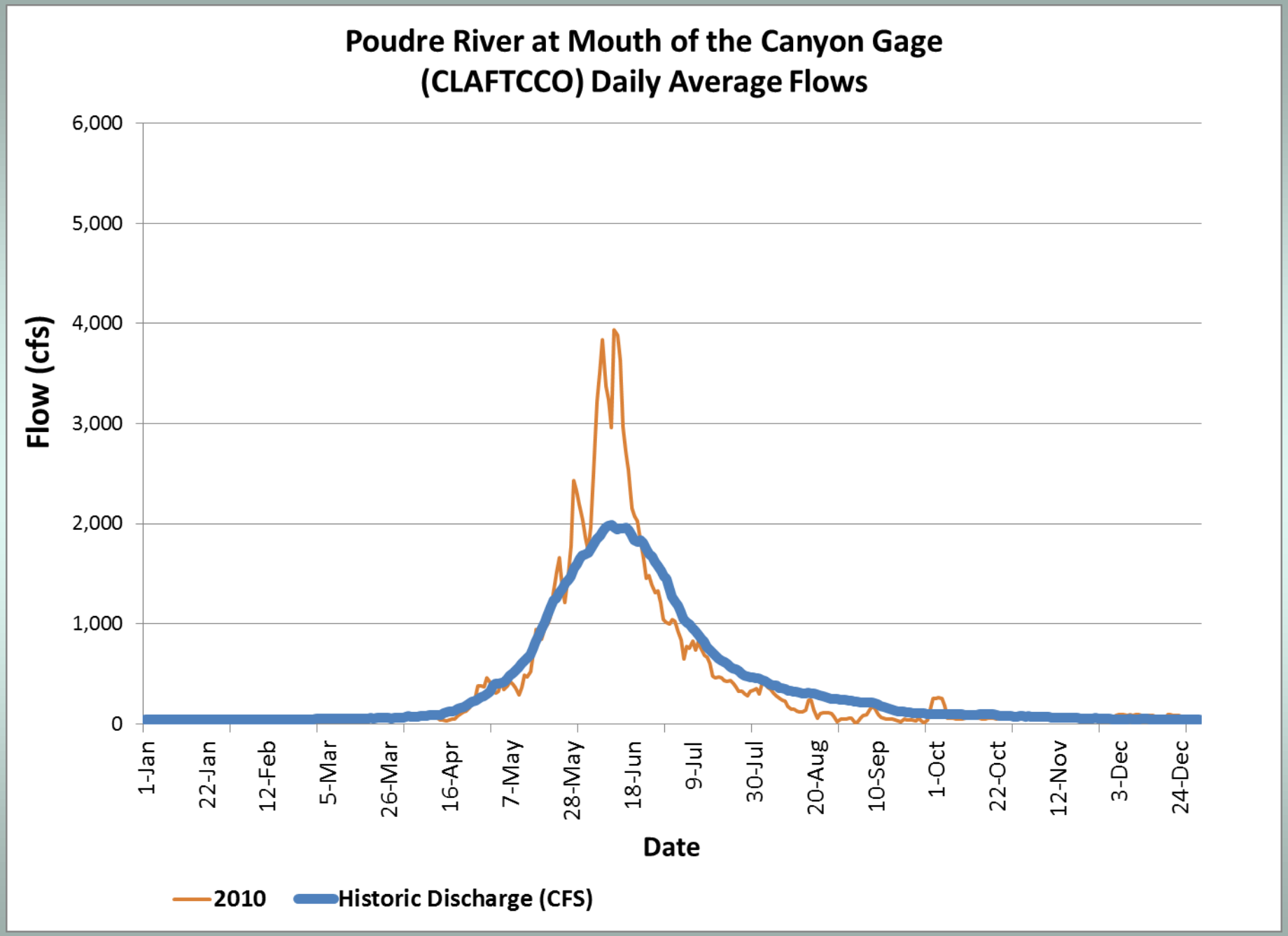
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

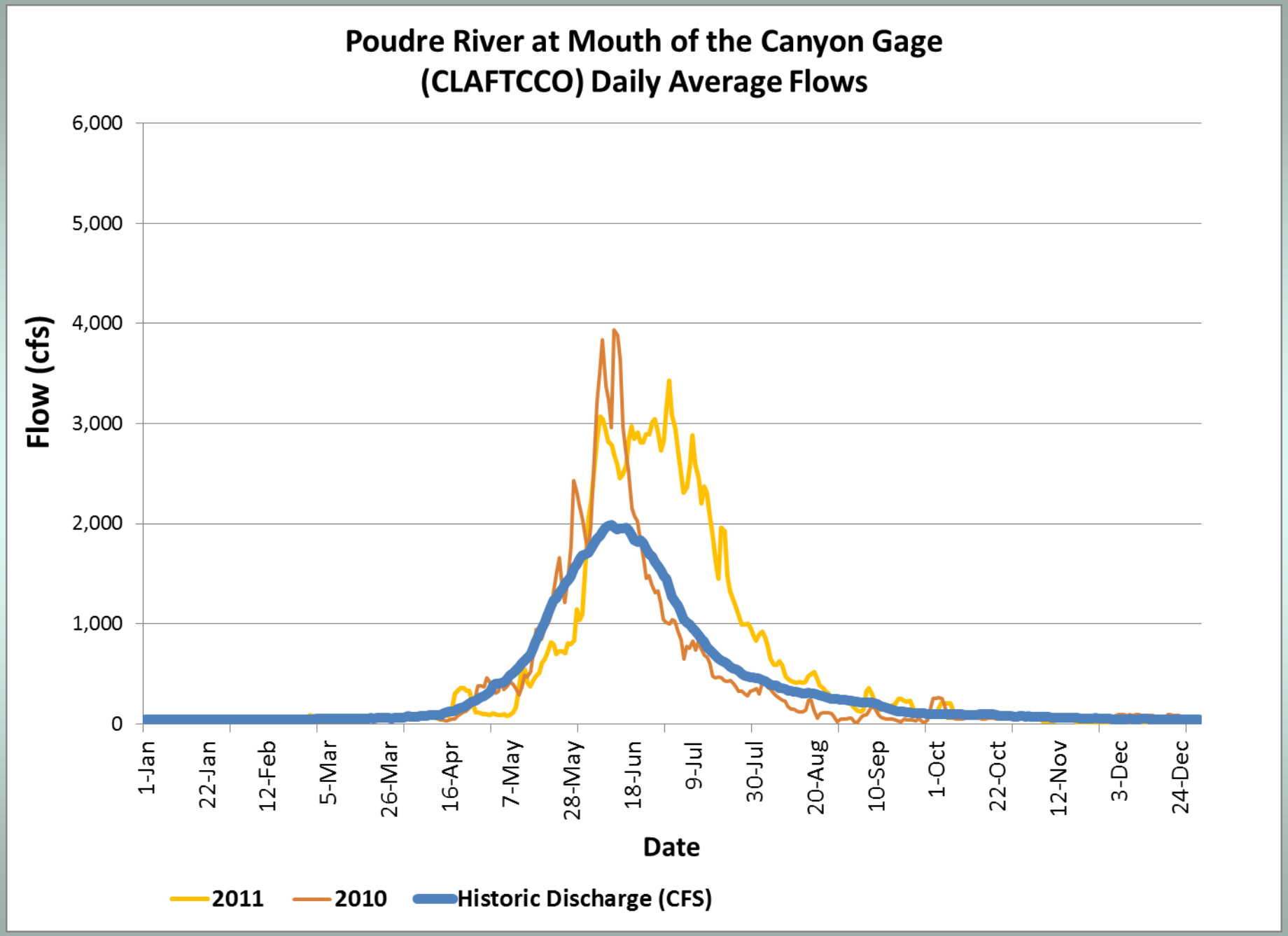
http://droughtmonitor.unl.edu/

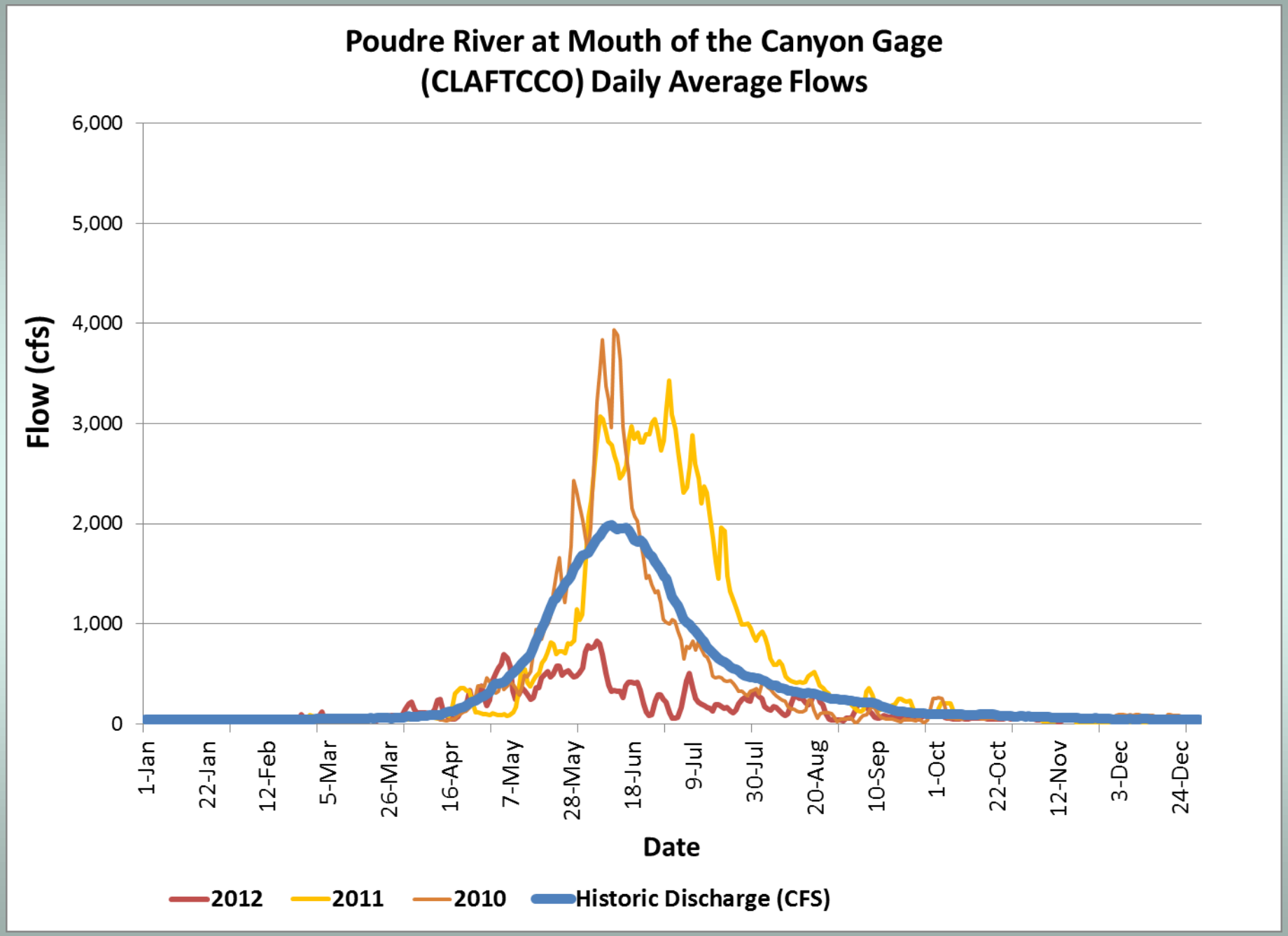
Released Thursday, July 18, 2013

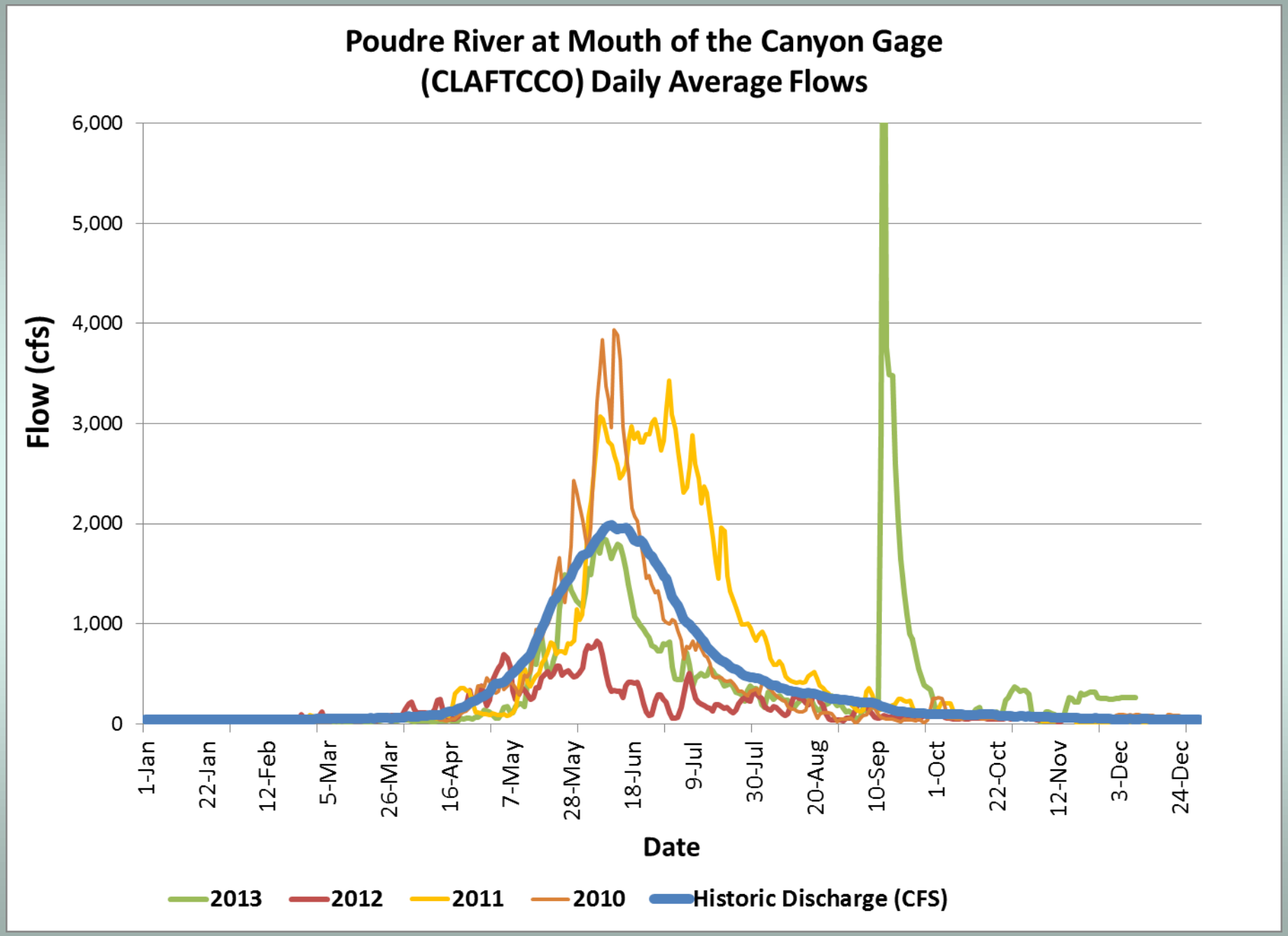
Author: Richard Heim, NOAA/NESDIS/NCDC

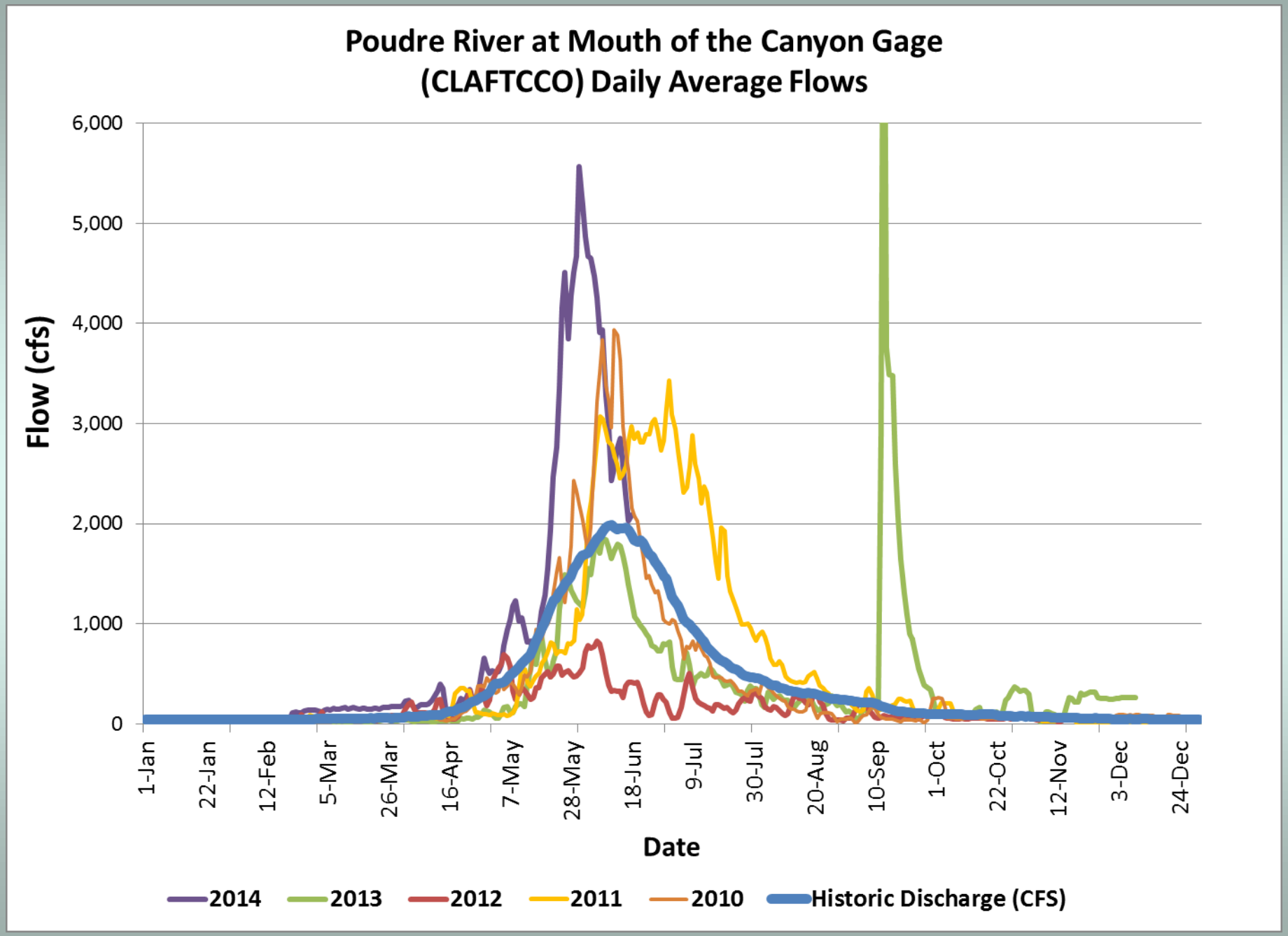
Streamflow–
the Great Climate Integrator


Poudre River at Mouth of the Canyon Gage (CLAFTCCO) Daily Average Flows
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan
22-Jan
12-Feb
5-Mar
26-Mar
16-Apr
7-May
28-May
18-Jun
9-Jul
30-Jul
20-Aug
10-Sep
1-Oct
22-Oct
12-Nov
3-Dec
24-Dec
Date
2010
Historic Discharge (CFS)


Poudre River at Mouth of the Canyon Gage (CLAFTCCO) Daily Average Flows
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan
22-Jan
12-Feb
5-Mar
26-Mar
16-Apr
7-May
28-May
18-Jun
9-Jul
30-Jul
20-Aug
10-Sep
1-Oct
22-Oct
12-Nov
3-Dec
24-Dec
Date
2011
2010
Historic Discharge (CFS)


Poudre River at Mouth of the Canyon Gage (CLAFTCCO) Daily Average Flows
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan
22-Jan
12-Feb
5-Mar
26-Mar
16-Apr
7-May
28-May
18-Jun
9-Jul
30-Jul
20-Aug
10-Sep
1-Oct
22-Oct
12-Nov
3-Dec
24-Dec
Date
2012
2011
2010
Historic Discharge (CFS)


Poudre River at Mouth of the Canyon Gage (CLAFTCCO) Daily Average Flows
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan
22-Jan
12-Feb
5-Mar
26-Mar
16-Apr
7-May
28-May
18-Jun
9-Jul
30-Jul
20-Aug
10-Sep
1-Oct
22-Oct
12-Nov
3-Dec
24-Dec
Date
2013
2012
2011
2010
Historic Discharge (CFS)


Poudre River at Mouth of the Canyon Gage (CLAFTCCO) Daily Average Flows
Flow (cfs)
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan
22-Jan
12-Feb
5-Mar
26-Mar
16-Apr
7-May
28-May
18-Jun
9-Jul
30-Jul
20-Aug
10-Sep
1-Oct
22-Oct
12-Nov
3-Dec
24-Dec
Date
2014
2013
2012
2011
2010
Historic Discharge (CFS)

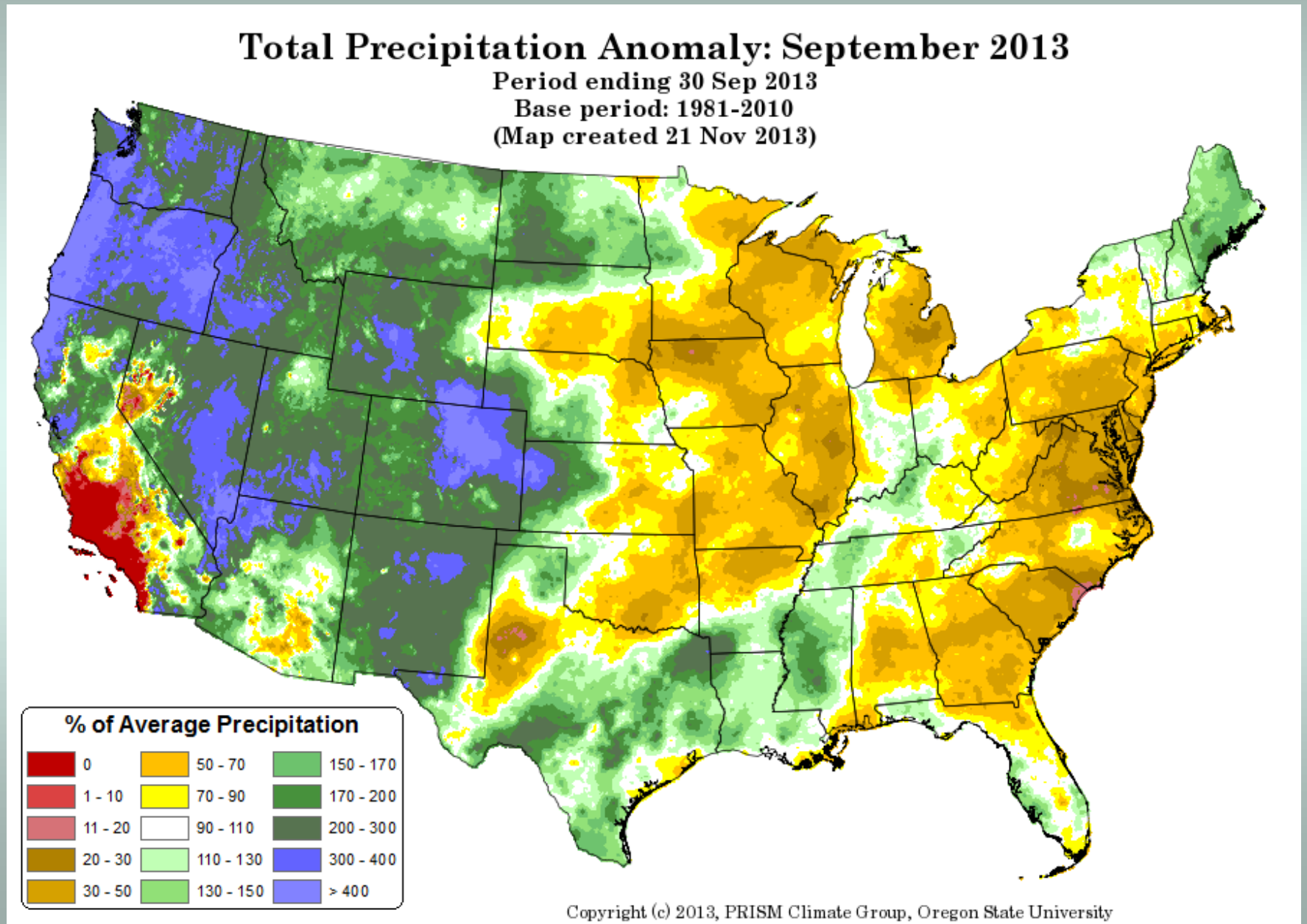
And then -- -- -- The 2013 Colorado Floods

A successful example of integrated monitoring

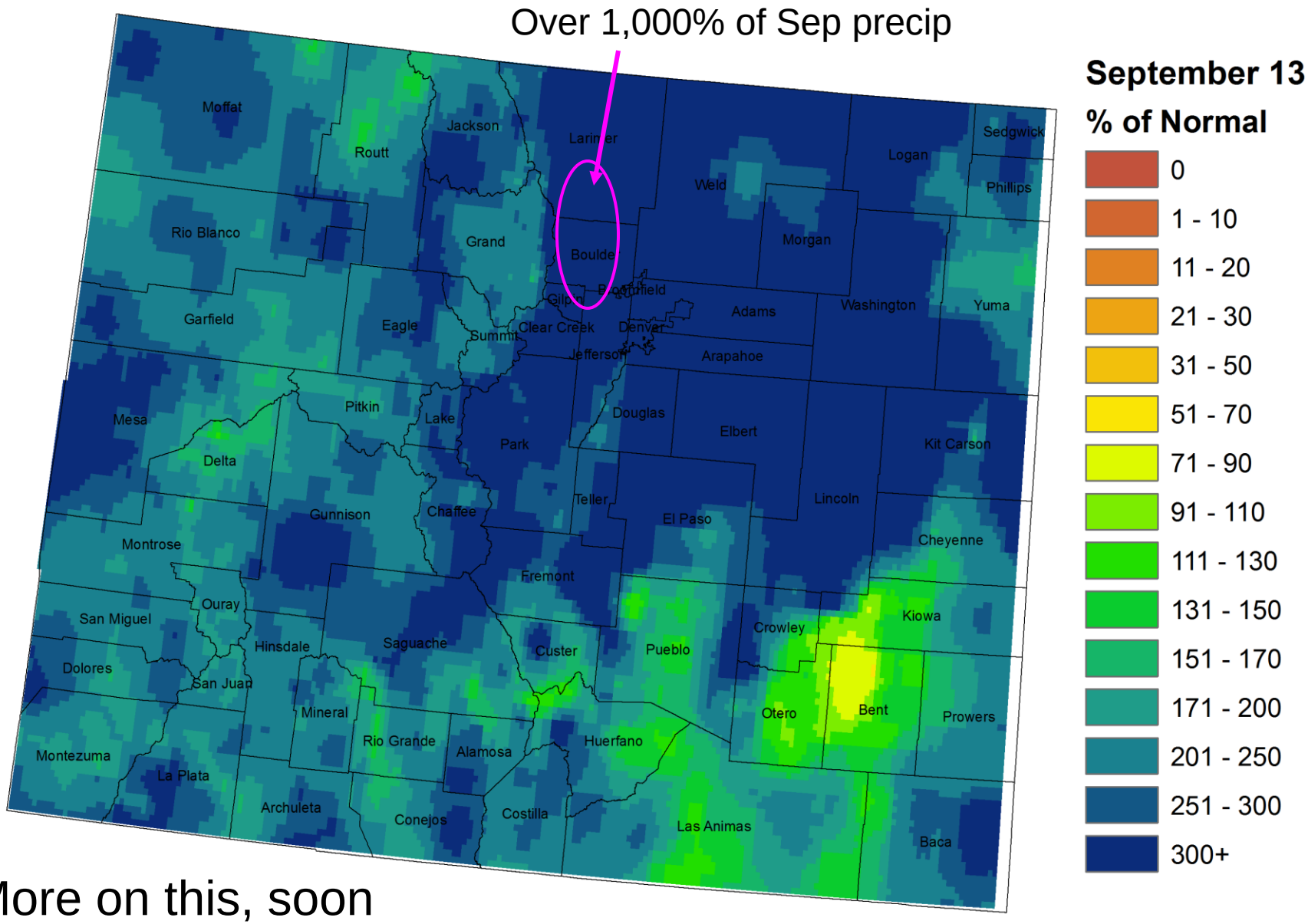

H&H
STOP


STOP
23H 1900 N
TACK

Sep 2013 Percent of Normal

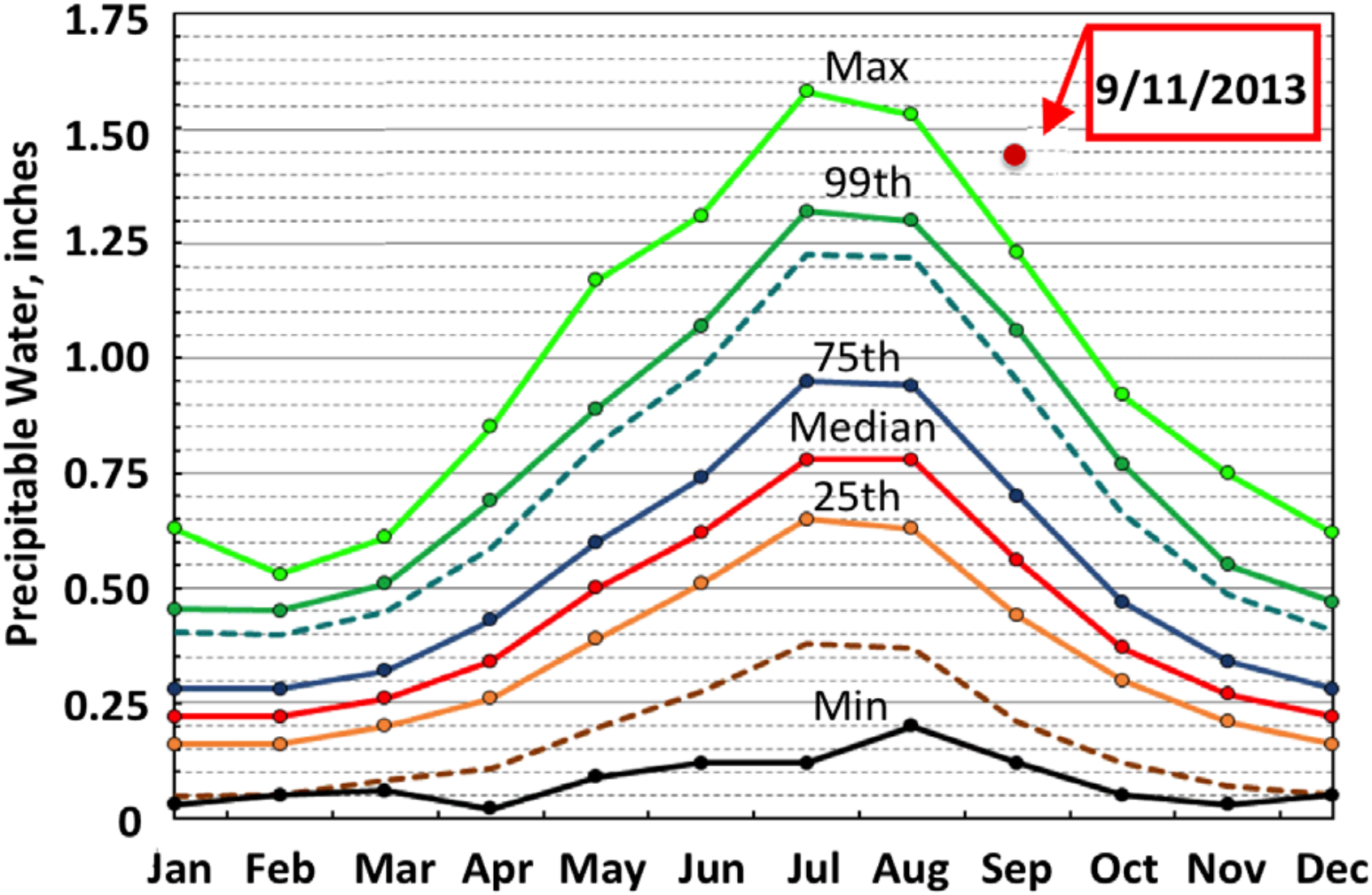


Colorado September 2013 Precipitation as Percentage of Normal

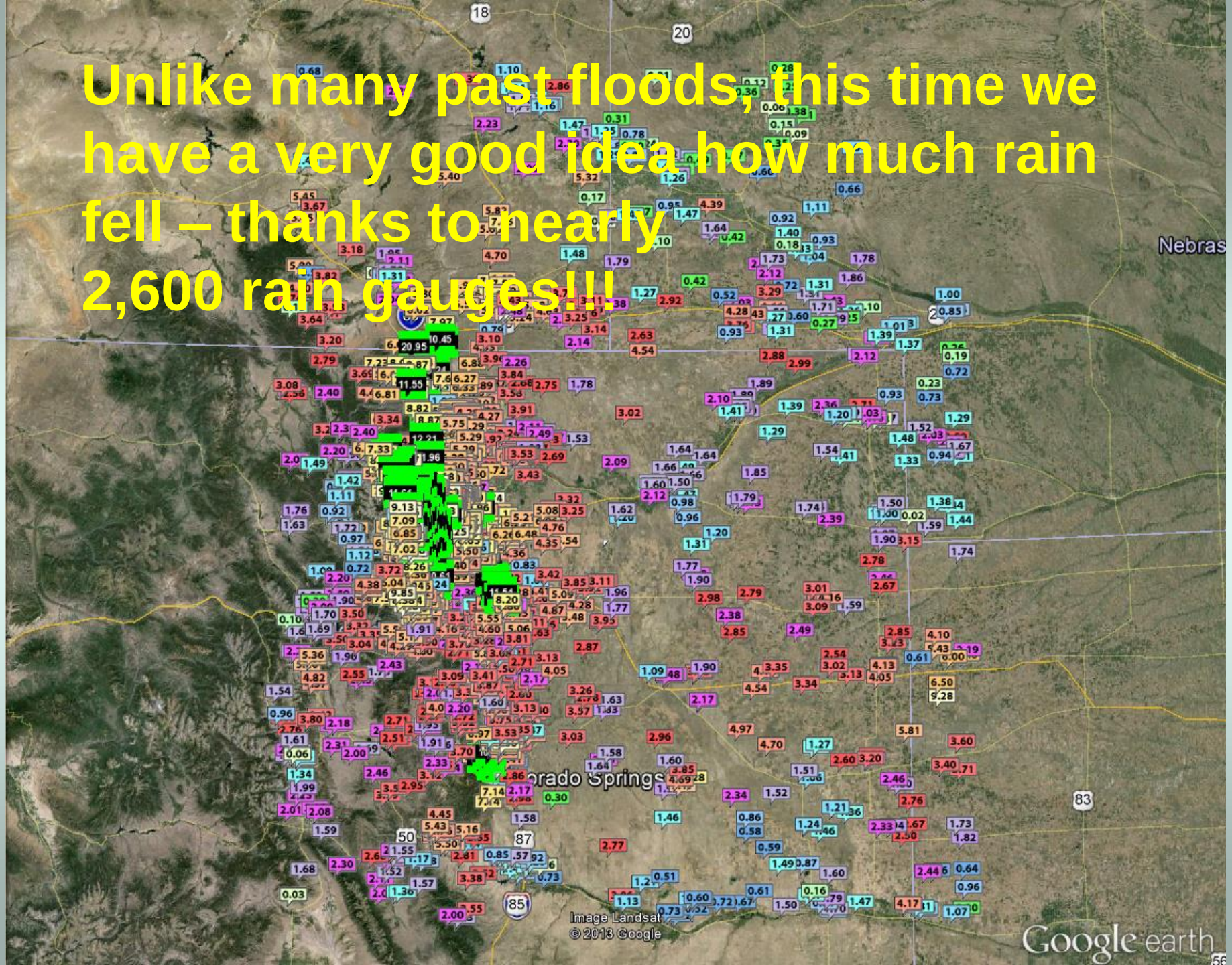


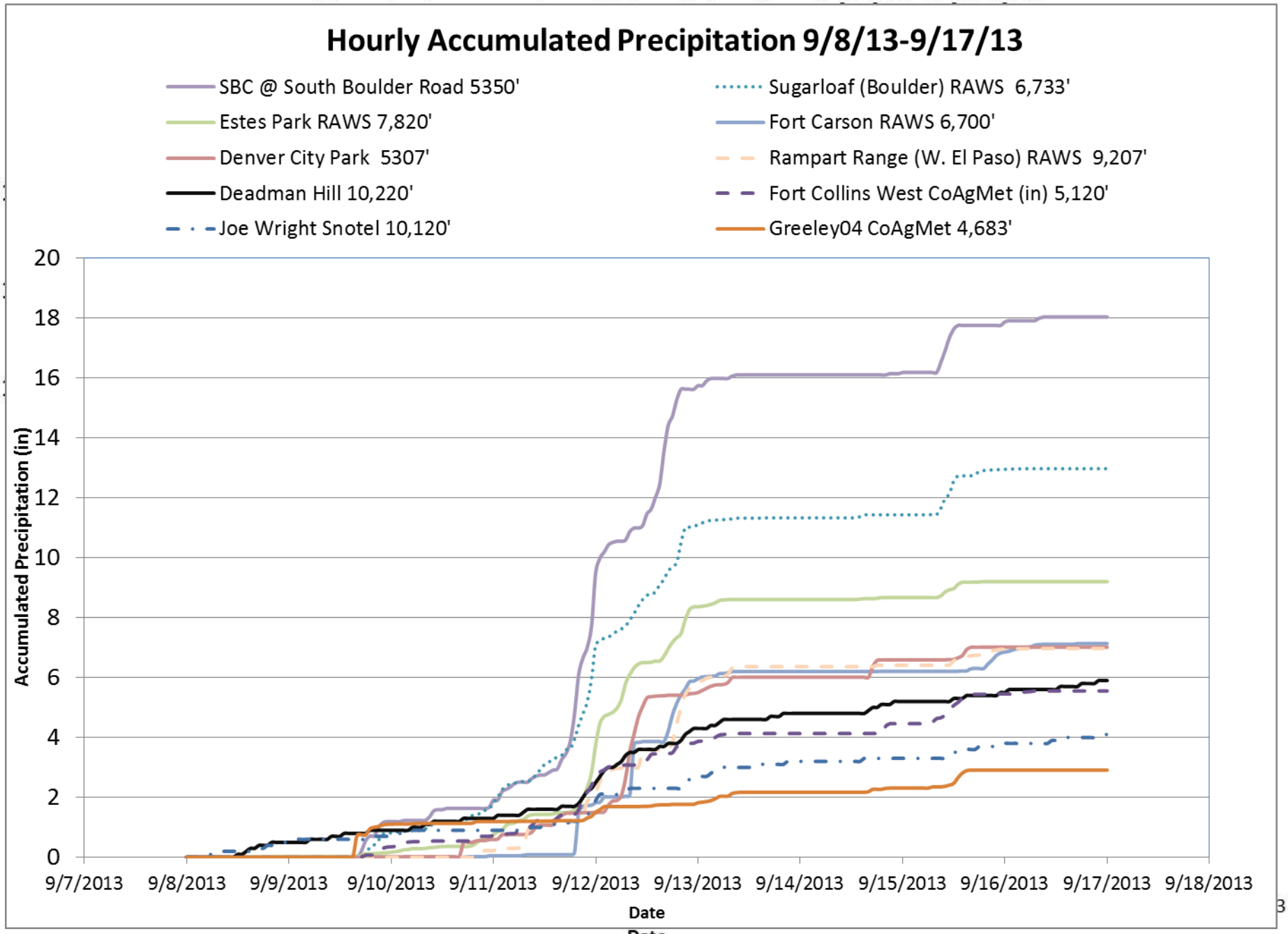
More on this, soon

Total Atmospheric Precipitable water over Denver from 1948 - 2012

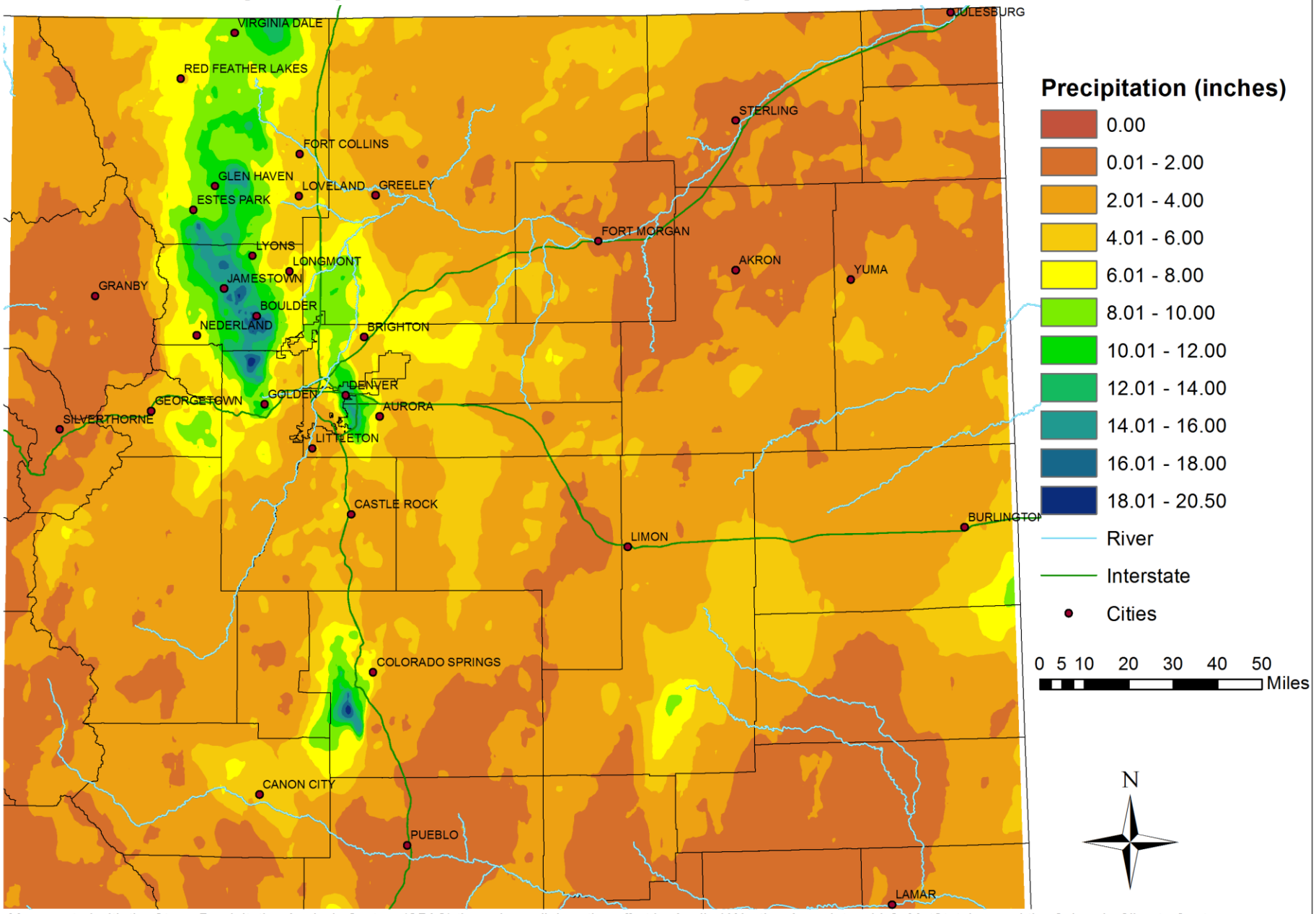


Unlike many past floods, this time we have a very good idea how much rain fell – thanks to nearly 2,600 rain gauges!!!




Hourly Accumulated Precipitation 9/8/13-9/17/13
SBC @ South Boulder Road 5350'
Sugarloaf (Boulder) RAWS 6,733'
Estes Park RAWS 7,820'
Fort Carson RAWS 6,700'
Denver City Park 5307'
Rampart Range (W. El Paso) RAWS 9,207'
Deadman Hill 10,220'
Fort Collins West CoAgMet (in) 5,120'
Joe Wright Snotel 10,120'
Greeley04 CoAgMet 4,683'
Accumulated Precipitation (in)
0
2
4
6
8
10
12
14
16
18
20
9/7/2013
9/8/2013
9/9/2013
9/10/2013
9/11/2013
9/12/2013
9/13/2013
9/14/2013
9/15/2013
9/16/2013
9/17/2013
9/18/2013
Date

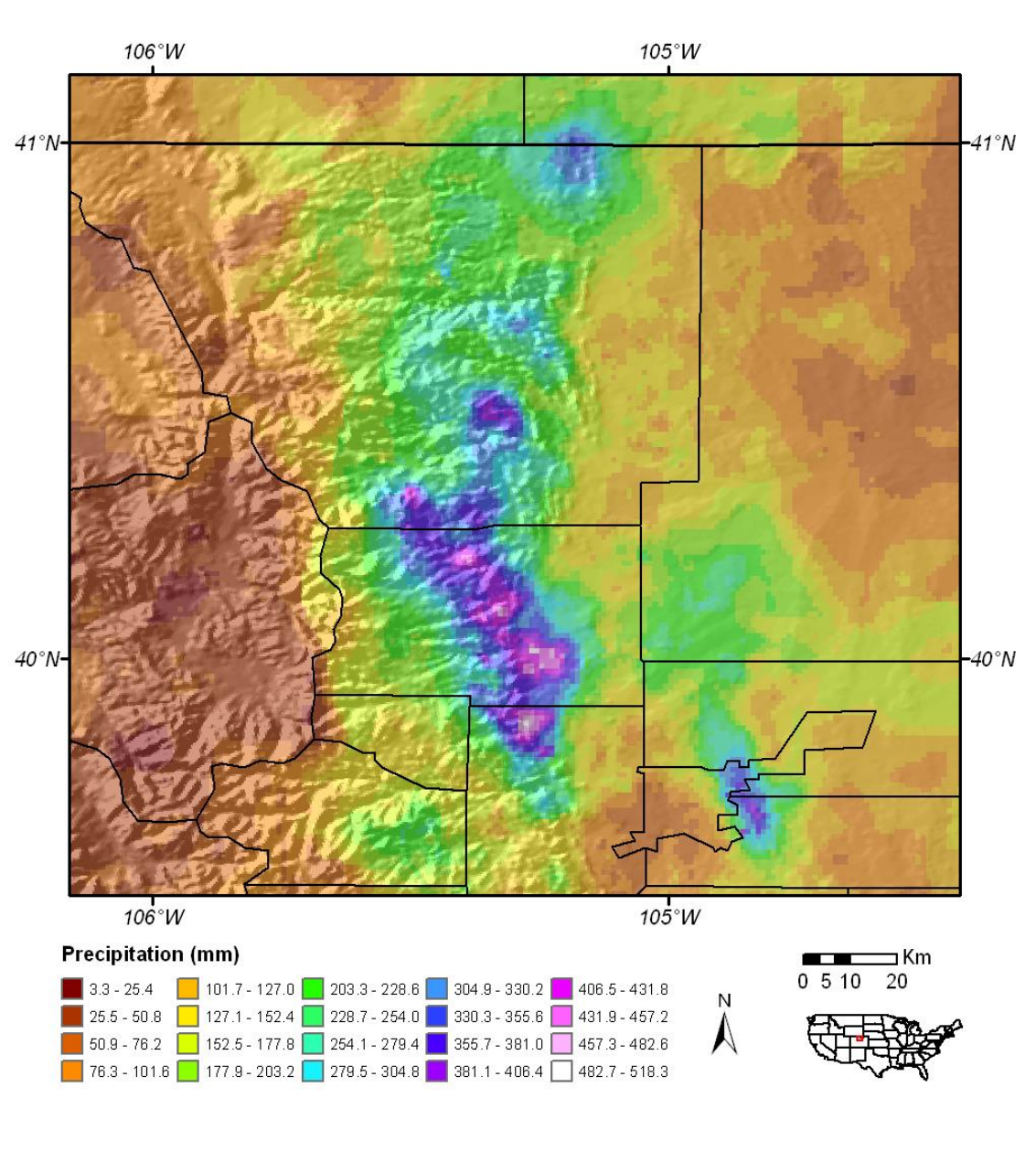
Precipitation beginning September 8, 2013 ending 7:00 AM MST September 17, 2013



Map created with the Storm Precipitation Analysis System (SPAS) through a collaborative effort by Applied Weather Associates, LLC, MetStat, Inc. and the Colorado Climate Center.
Radar data supplied by Weather Decision Technologies, Inc.

Storm-total Rainfall, north central Colorado, Sep 8-17, 2013

This storm is likely one of the 3-5 largest rain/flood events in Colorado's measured history back to the late 1890s



Top Total By County		
Stations Exceeding 10" of Rain		
Sep-13		
CO-BO-30	Boulder 1.9 SE	19.18
CO-LR-225	Drake 3.0 NNE	16.65
CO-AD-127	Aurora 4.2 NNW	16.63
CO-AR-270	Aurora 0.7 WSW	16.39
CO-DN-183	Denver 5.1 ENE	13.49
CO-EP-175	Manitou Springs 1.2 ESE	12.84
CO-JF-365	Golden 2.1 SW	12.64
CO-WE-203	Longmont 8.2 ESE	11.57
CO-CC-7	Idaho Springs 4.7 SSE	10.34

These day are preliminary – use only for general assessment

New Colorado one-day rainfall record set 12 Sep 2013

- Fort Carson Rod and Gun observing station (a USGS gauge)

  -- 11.85” calendar day total

  -- 12.46” for 24-hour period ending 9 AM Sep 13, 2013

The issue of data quality

- It’s not something most information users ever think about
- They simply assume the data provided are accurate and top quality

NIDIS (National Integrated Drought Information System)

Upper Colorado River Basin Drought Early Warning System information needs assessment results

Some key findings

- Preserve all long-term stations in as many geographic locations as possible
- Collect precip and snow accumulation so relationships of what falls as rain, what falls as snow, and what stays on the ground as snow, can be tracked accurately

- More SNOTEL desired at varieties of elevation, not just peak SWE areas (willing to share costs of hardware, but not O&M)
- Critical to preserve snow courses (for data continuity/representativeness)
- Need better information on elevational distribution of snow
- Snow sublimation
- Soil moisture beneath snowpack in historic perspective

- Additional stream gauging sites needed (no cuts, particularly any and all long-term stations)
- Document extreme events quickly and provide frequency estimates
- Need “native flow” information in real time.
- Remote sensing (preference for local point data but may change mind if results show improvements in water supply forecasts)

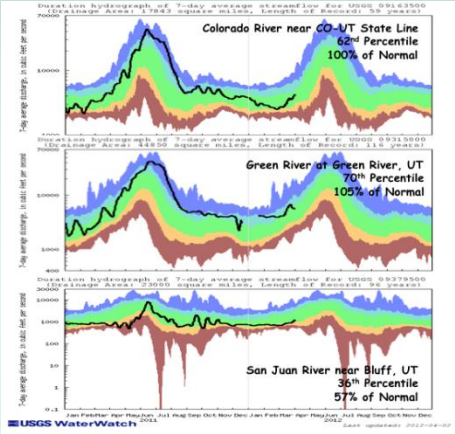
Reservoir information

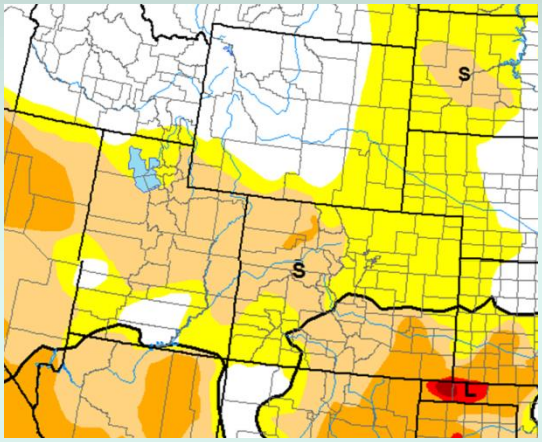
- Interest in better climatological perspective on reservoirs – daily rate of change, seasonal cycles, year to year variations -- basically better visualization.

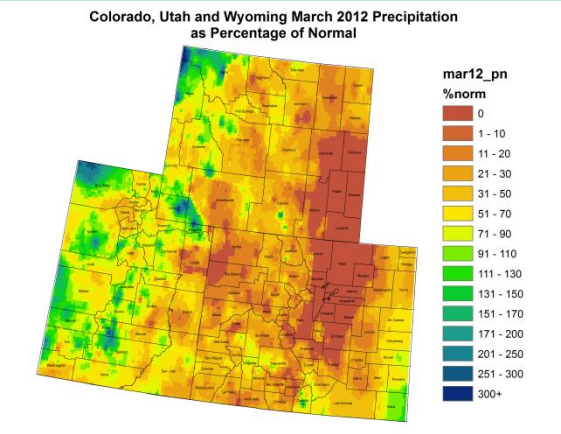
Finally, HUGE INTEREST in anything that will provide and improve current year water supply forecasts and “year two” forecasts as well as longer term projections

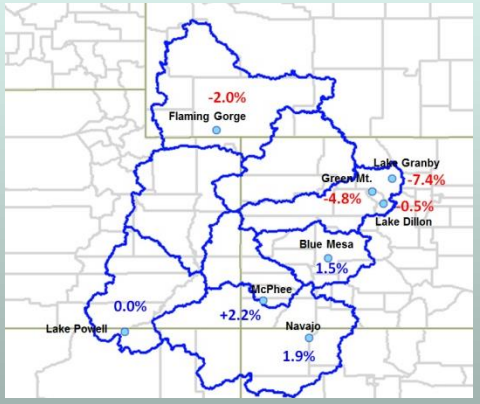
As such, improved ocean monitoring including TAO a high priority

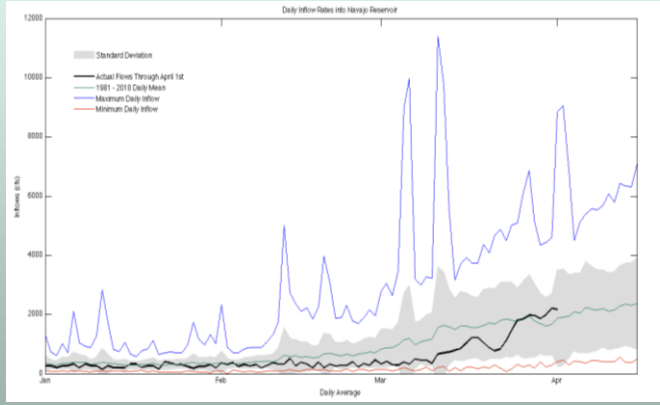
Weekly Climate Updates Available Upper Colorado Regional Drought Early Warning

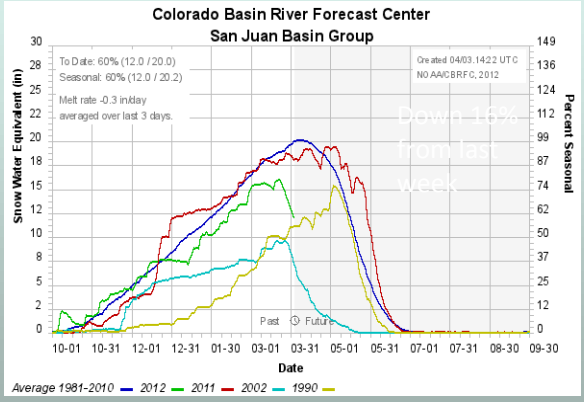












Whatever comes next is sure to be “very interesting”

So . . My question is "Do you have a rain gauge?"

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

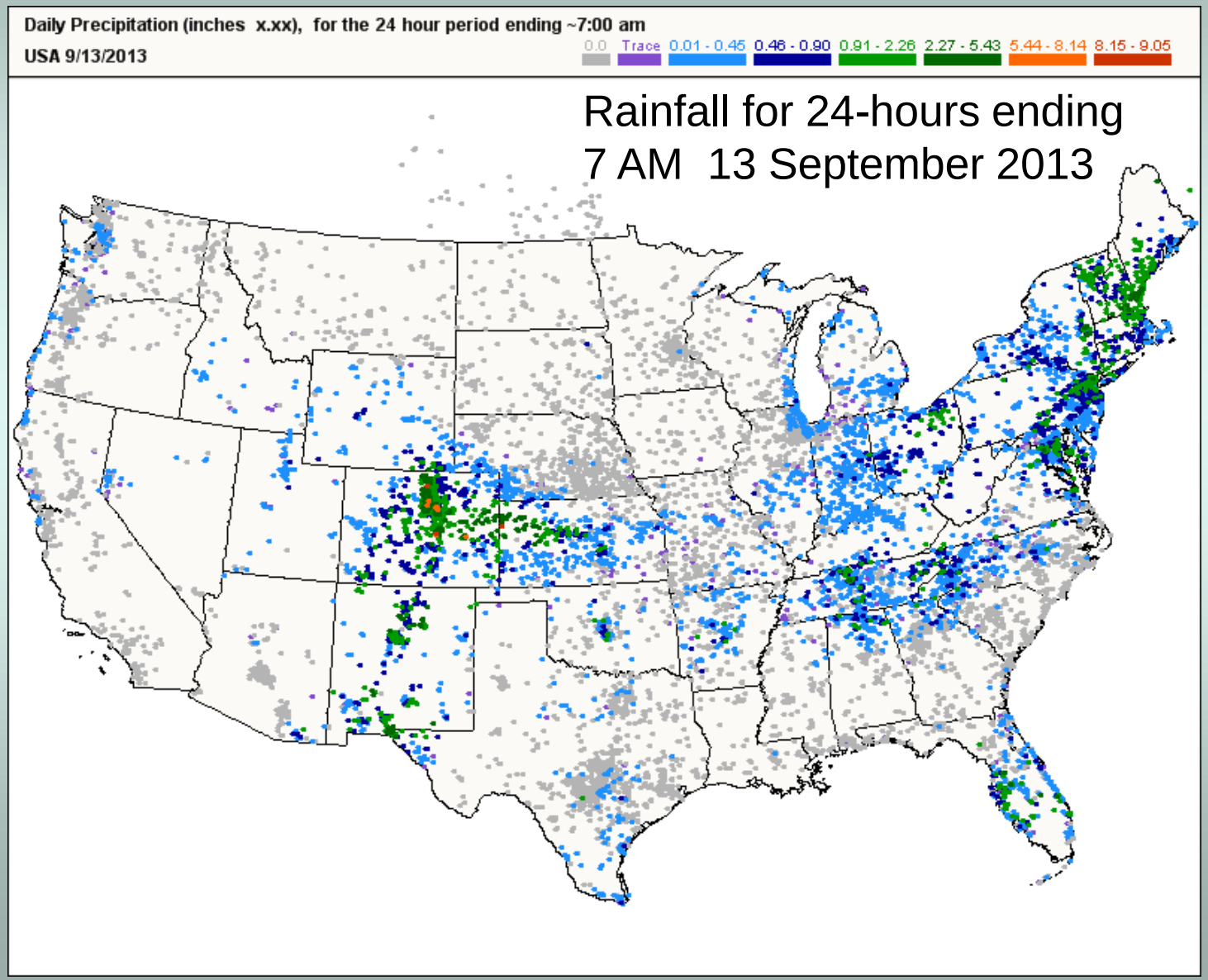
http://www.cocorahs.org

or see me today

CoCoRaHS (Community Collaborative Rain, Hail and Snow) – A simple but effective way to help scientists track our climate

http://www.cocorahs.org

Mapping our water as it lands:
-The Value of Gauged Volunteers -



Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/1998	Standard	Get Map

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

USA 9/12/1998

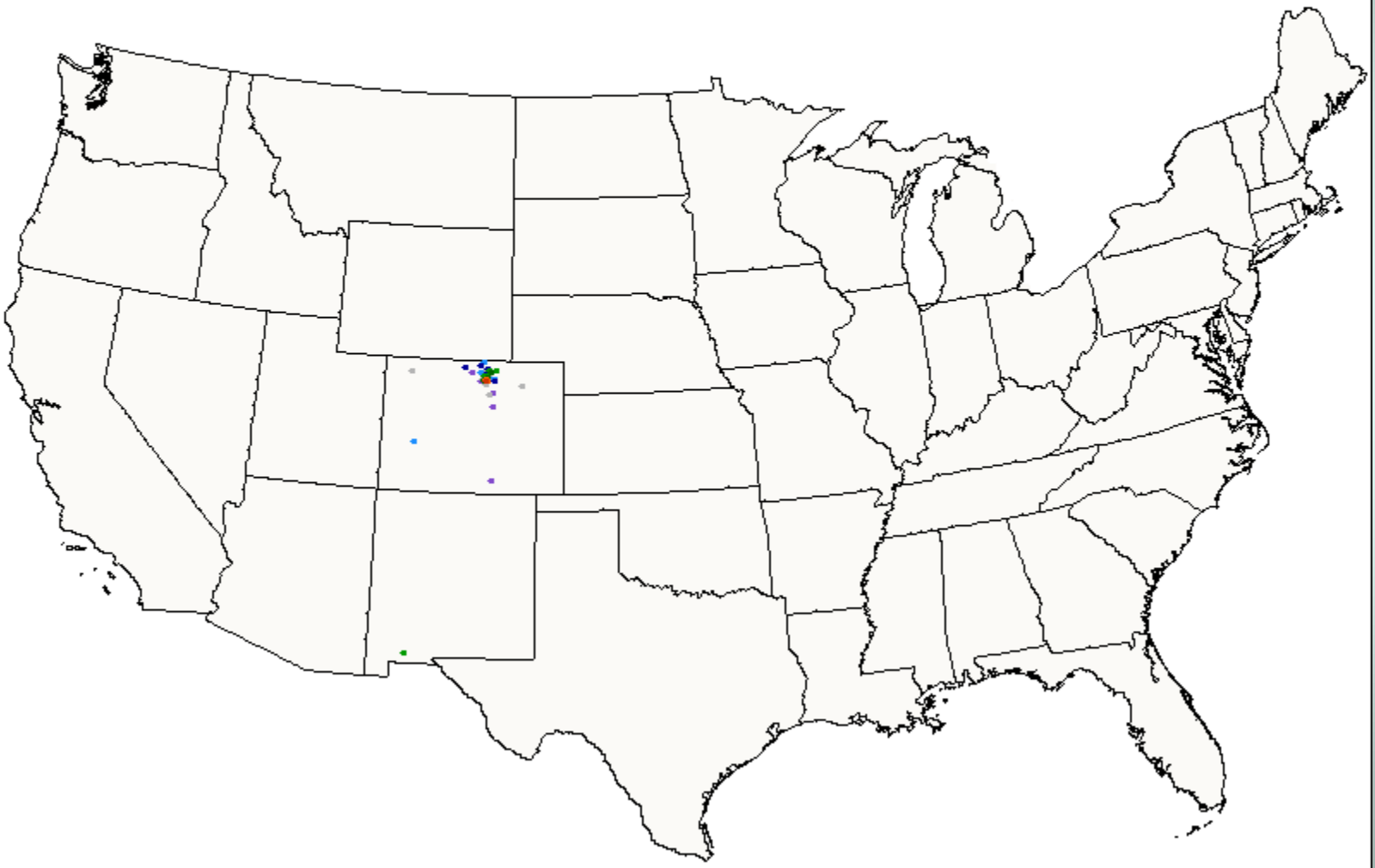
0.0 | Trace | 0.01 - 0.03 | 0.04 - 0.06 | 0.07 - 0.16 | 0.17 - 0.38 | 0.39 - 0.57 | 0.58 - 0.64

Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/1999	Standard	Get Map

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

USA 9/12/1999

0.0 | Trace | 0.01 - 0.03 | 0.04 - 0.06 | 0.07 - 0.14 | 0.15 - 0.33 | 0.34 - 0.50 | 0.51 - 0.55



Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2000	Standard	Get Map

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

USA 9/12/2000

0.0 | Trace | 0.01 - 0.02 | 0.03 - 0.04 | 0.05 - 0.10 | 0.11 - 0.24 | 0.25 - 0.36 | 0.37 - 0.40

Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2001	Standard	Get Map

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

USA 9/12/2001

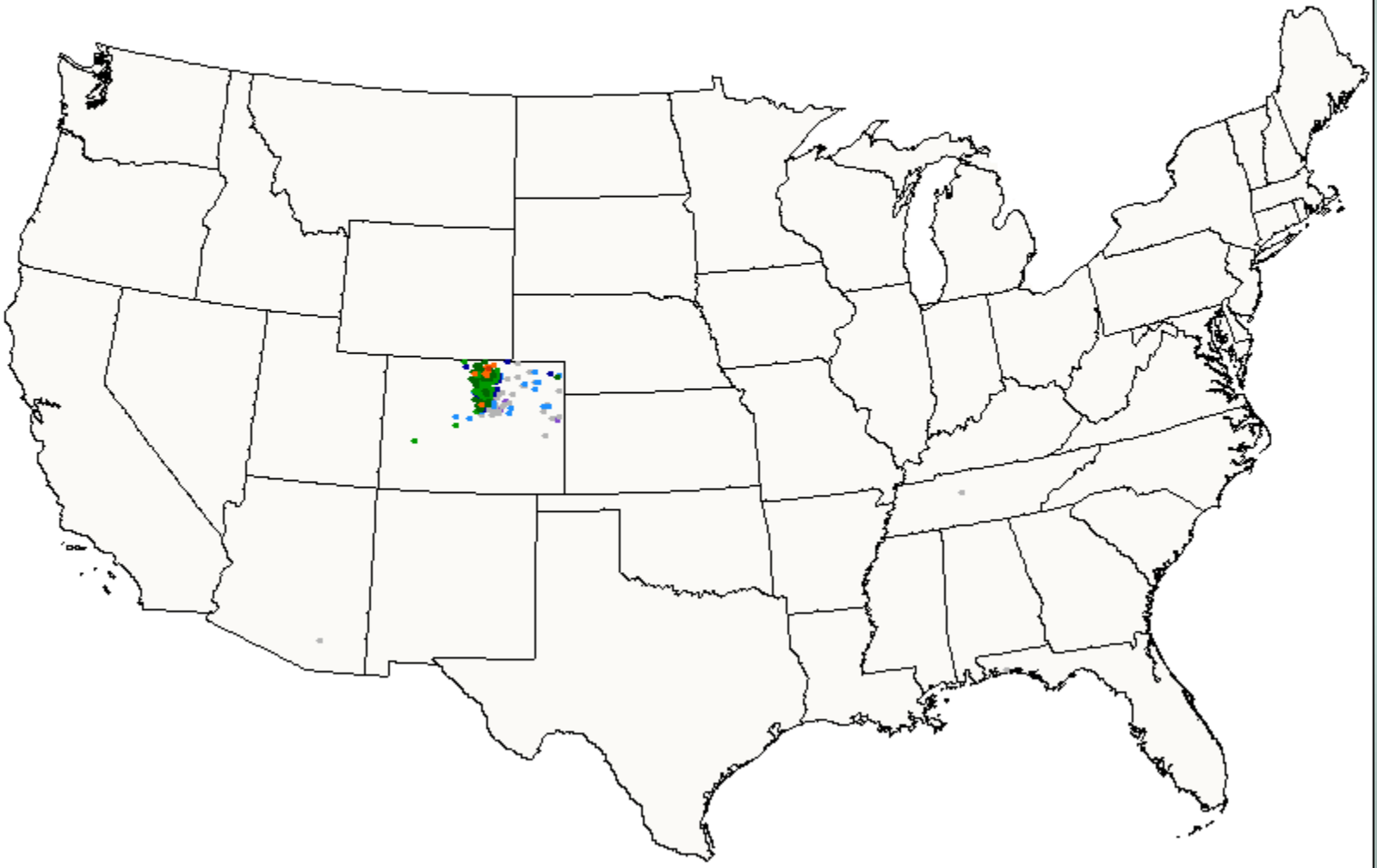
0.0 | Trace | 0.01 - 0.01 | 0.02 - 0.02 | 0.03 - 0.05 | 0.06 - 0.12 | 0.13 - 0.18 | 0.19 - 0.21

Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2002	Standard	Get Map

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

USA 9/12/2002

0.0 | Trace | 0.01 - 0.07 | 0.08 - 0.14 | 0.15 - 0.34 | 0.35 - 0.80 | 0.81 - 1.20 | 1.21 - 1.32

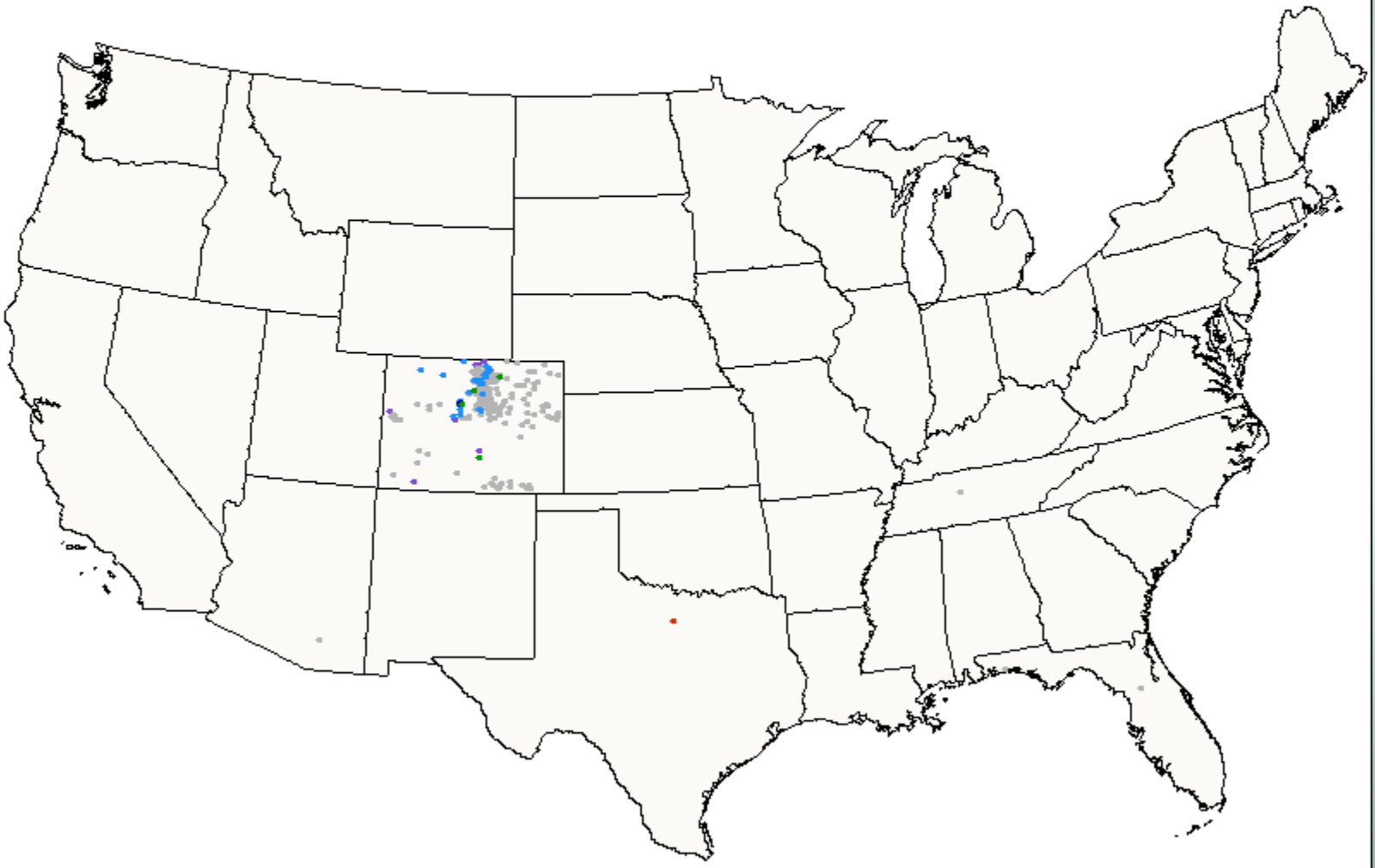


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2003	Standard	Get Map

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

USA 9/12/2003

0.0 | Trace | 0.01 - 0.03 | 0.04 - 0.06 | 0.07 - 0.15 | 0.16 - 0.36 | 0.37 - 0.54 | 0.55 - 0.61

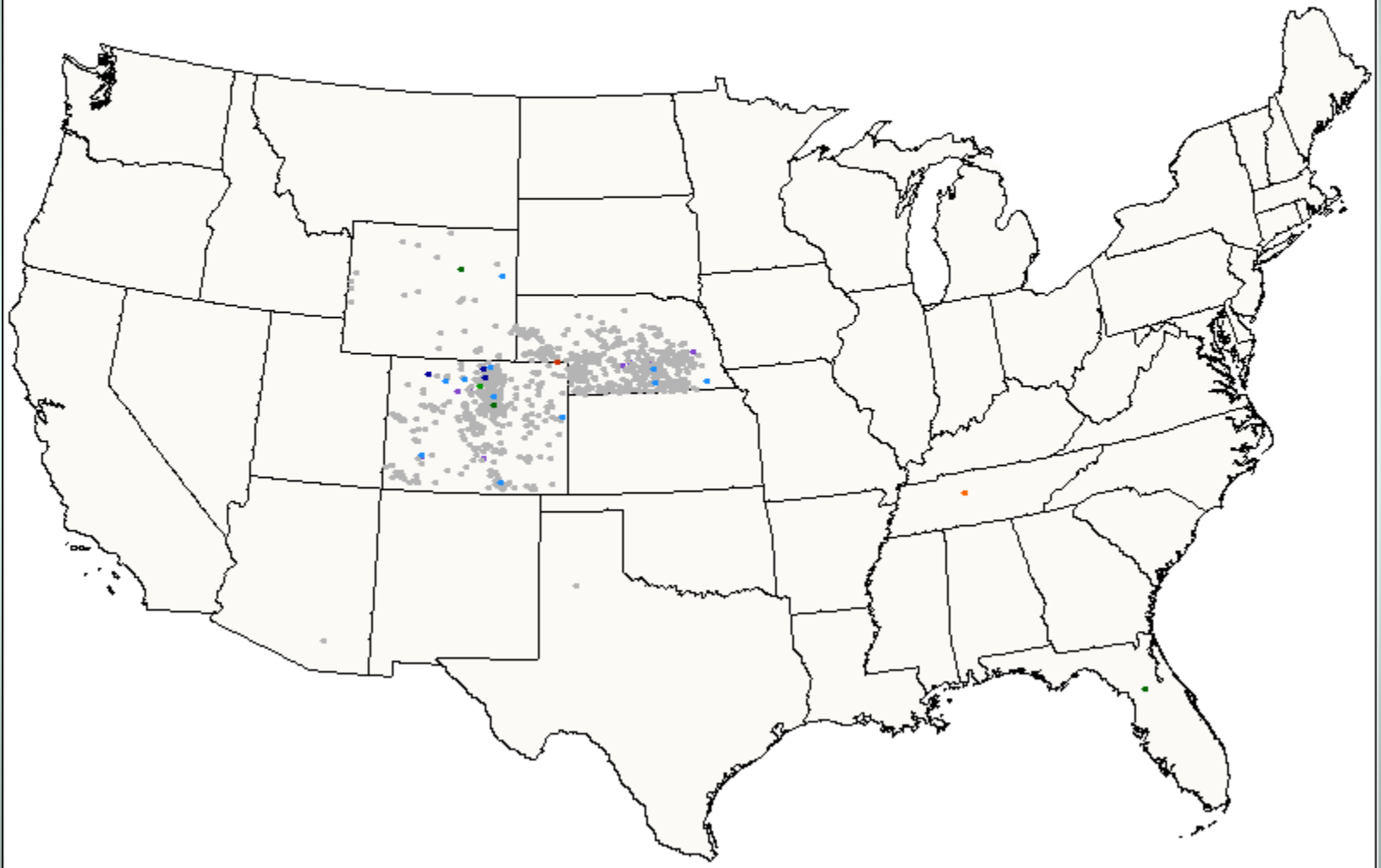


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2004	Standard	Get Map

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

USA 9/12/2004

0.0 | Trace | 0.01 - 0.03 | 0.04 - 0.06 | 0.07 - 0.16 | 0.17 - 0.40 | 0.41 - 0.60 | 0.61 - 0.68

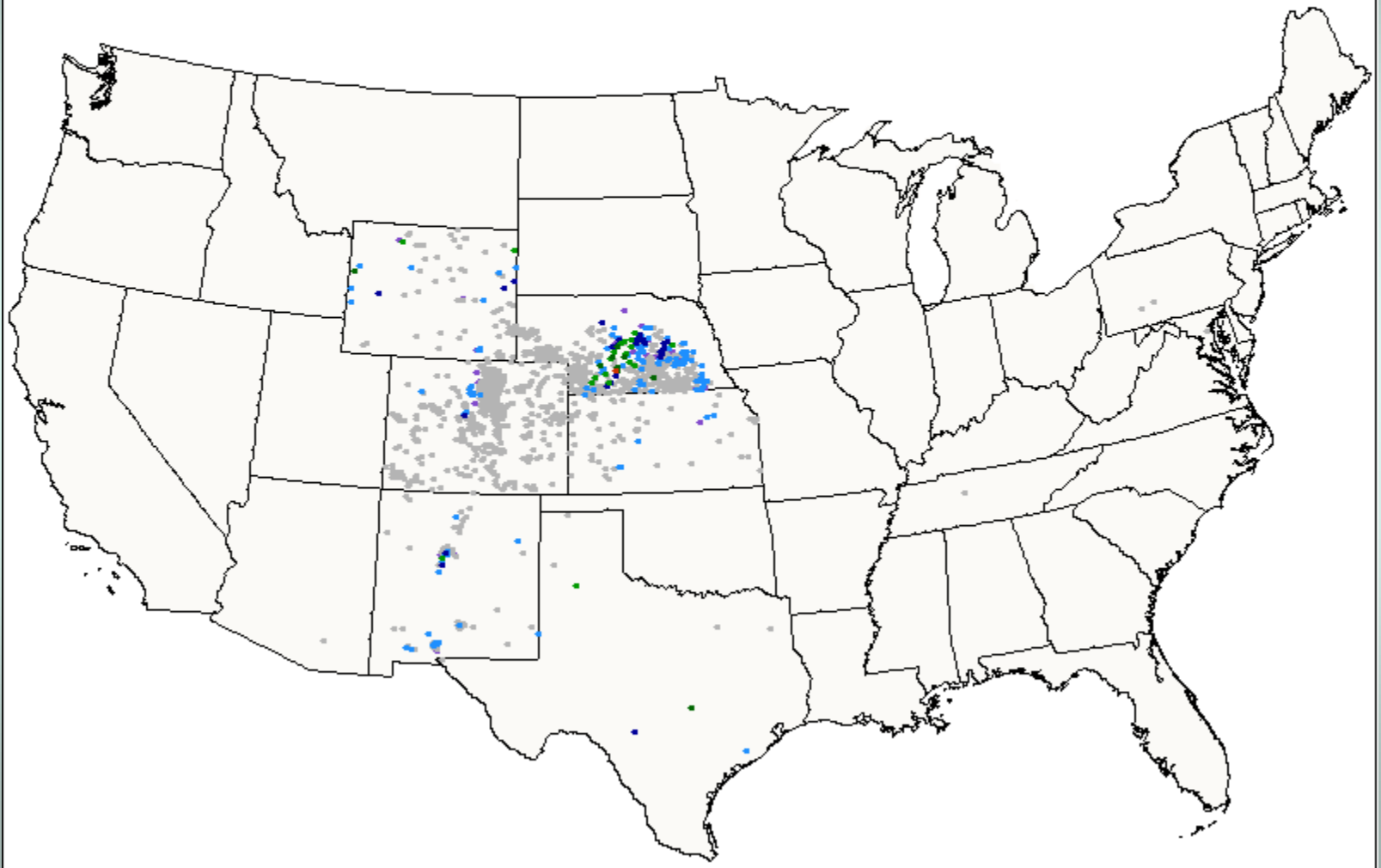


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2005	Standard	Get Map

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

USA 9/12/2005

0.0 | Trace | 0.01 - 0.08 | 0.09 - 0.16 | 0.17 - 0.40 | 0.41 - 0.95 | 0.96 - 1.42 | 1.43 - 1.58

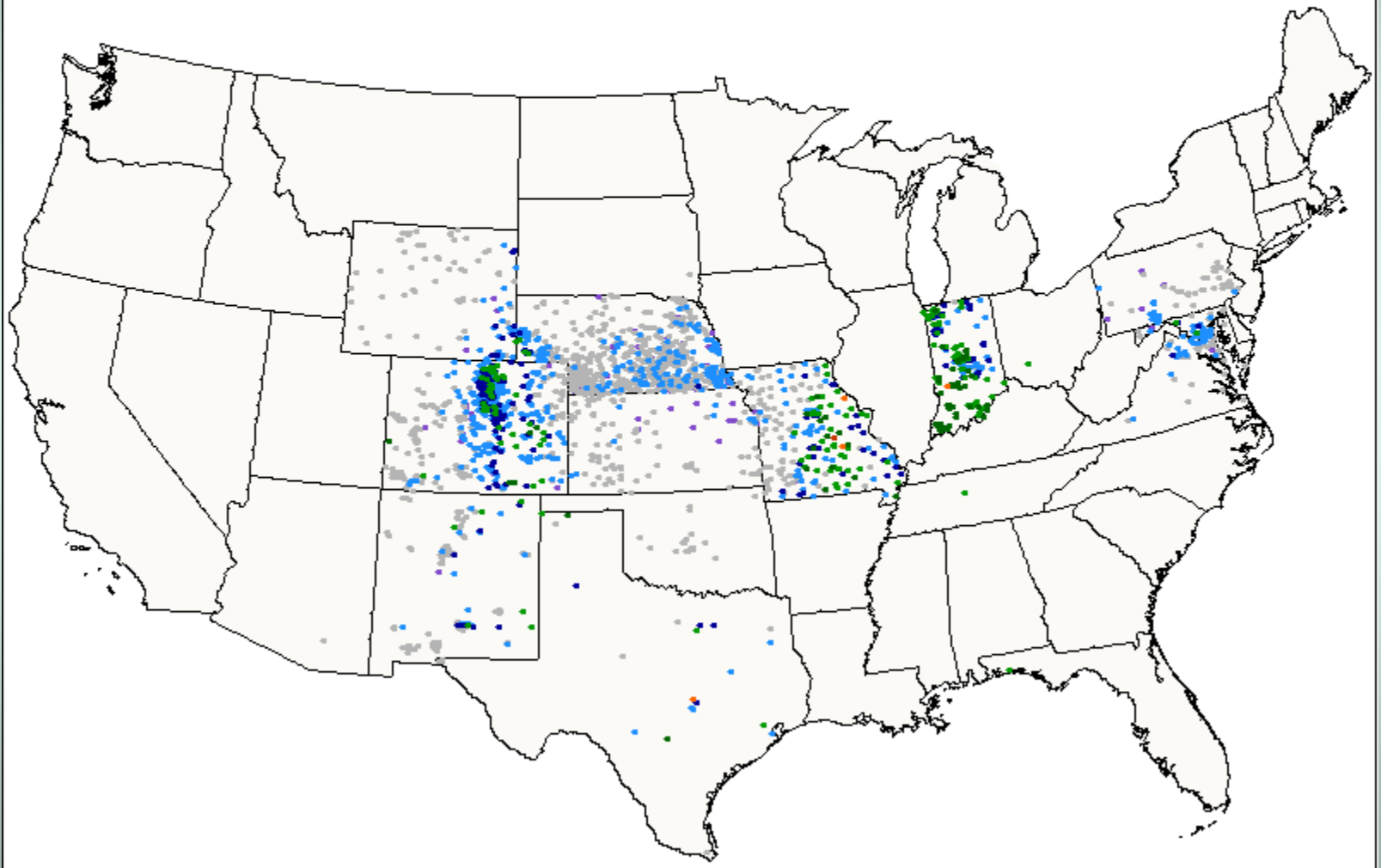


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2006	Standard	Get Map

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

USA 9/12/2006

0.0 | Trace | 0.01 - 0.18 | 0.19 - 0.36 | 0.37 - 0.90 | 0.91 - 2.16 | 2.17 - 3.24 | 3.25 - 3.59

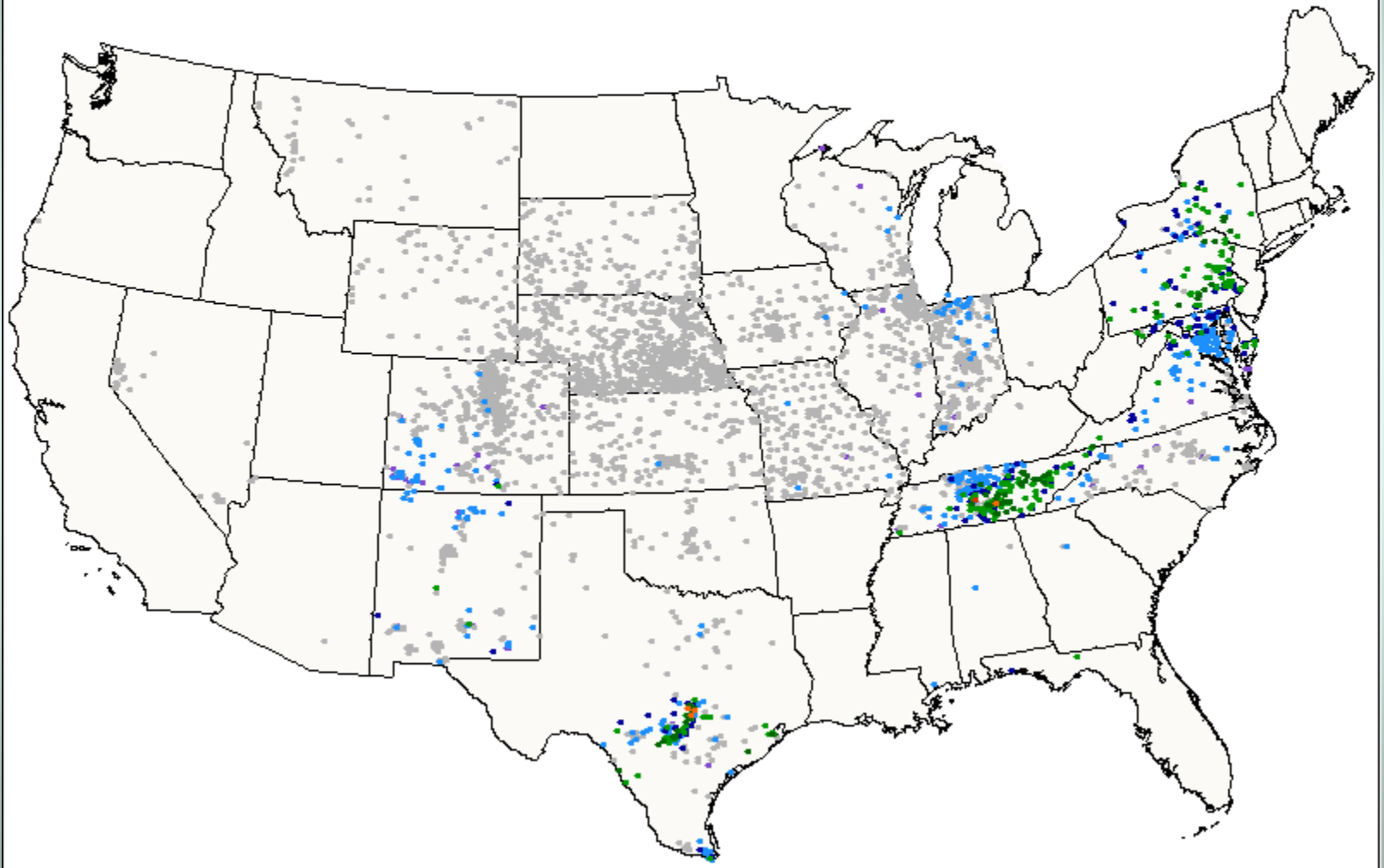


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2007	Standard	Get Map

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

USA 9/12/2007

0.0 | Trace | 0.01 - 0.18 | 0.19 - 0.36 | 0.37 - 0.92 | 0.93 - 2.22 | 2.23 - 3.33 | 3.34 - 3.70

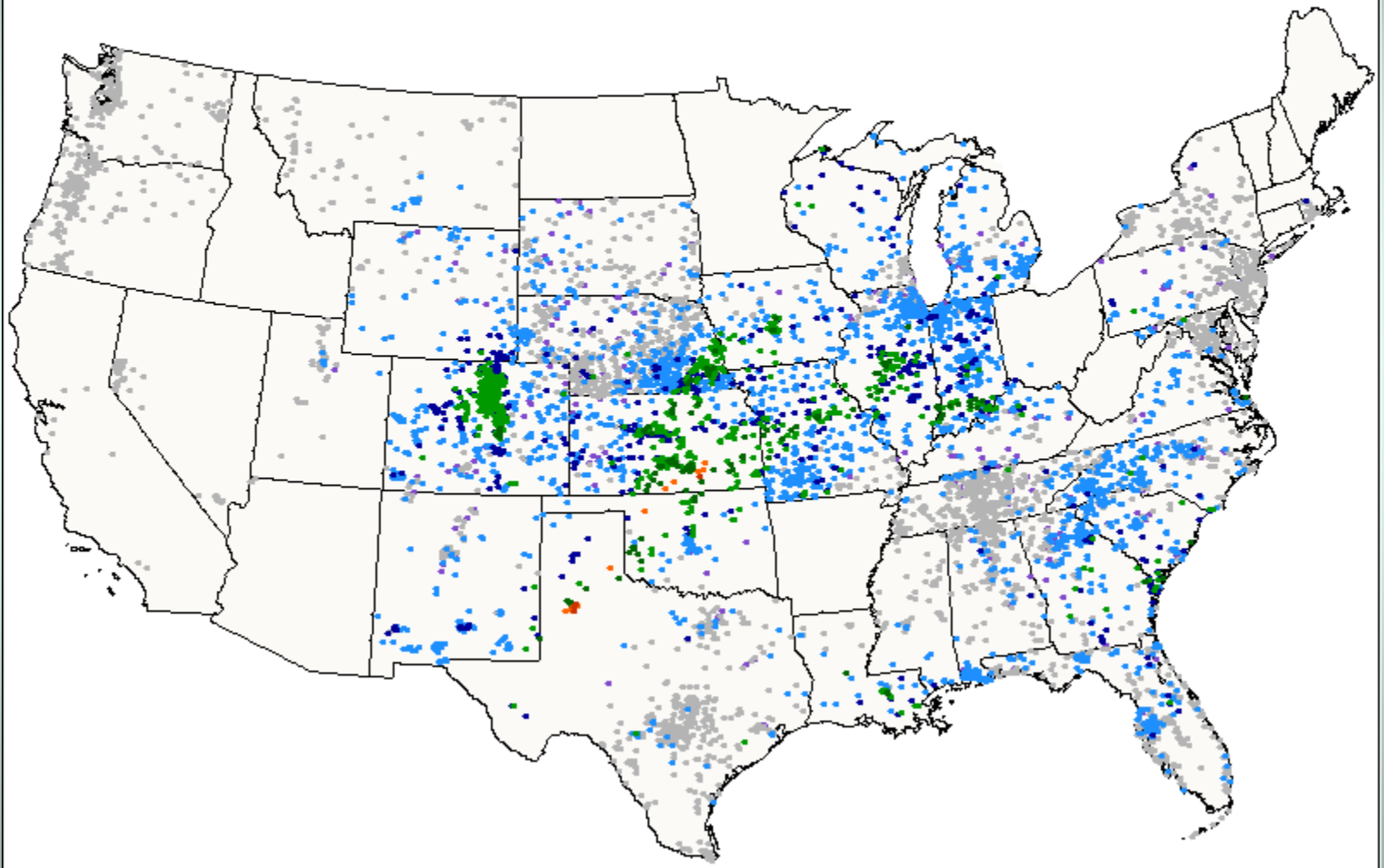


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2008	Standard	Get Map

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

USA 9/12/2008

0.0 | Trace | 0.01 - 0.41 | 0.42 - 0.82 | 0.83 - 2.05 | 2.06 - 4.92 | 4.93 - 7.38 | 7.39 - 8.21

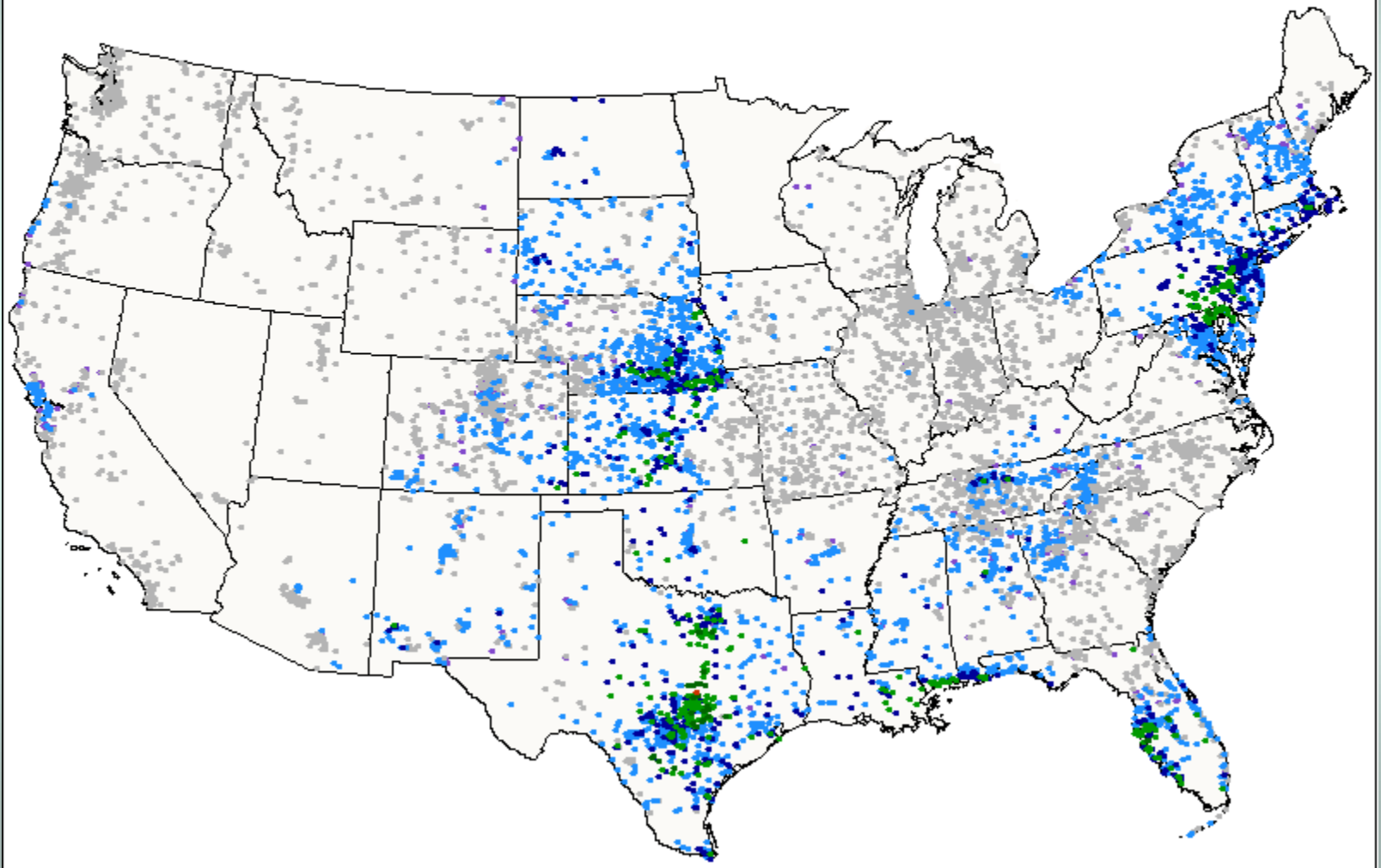


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2009	Standard	Get Map

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

USA 9/12/2009

0.0 | Trace | 0.01 - 0.72 | 0.73 - 1.44 | 1.45 - 3.59 | 3.60 - 8.61 | 8.62 - 12.91 | 12.92 - 14.33

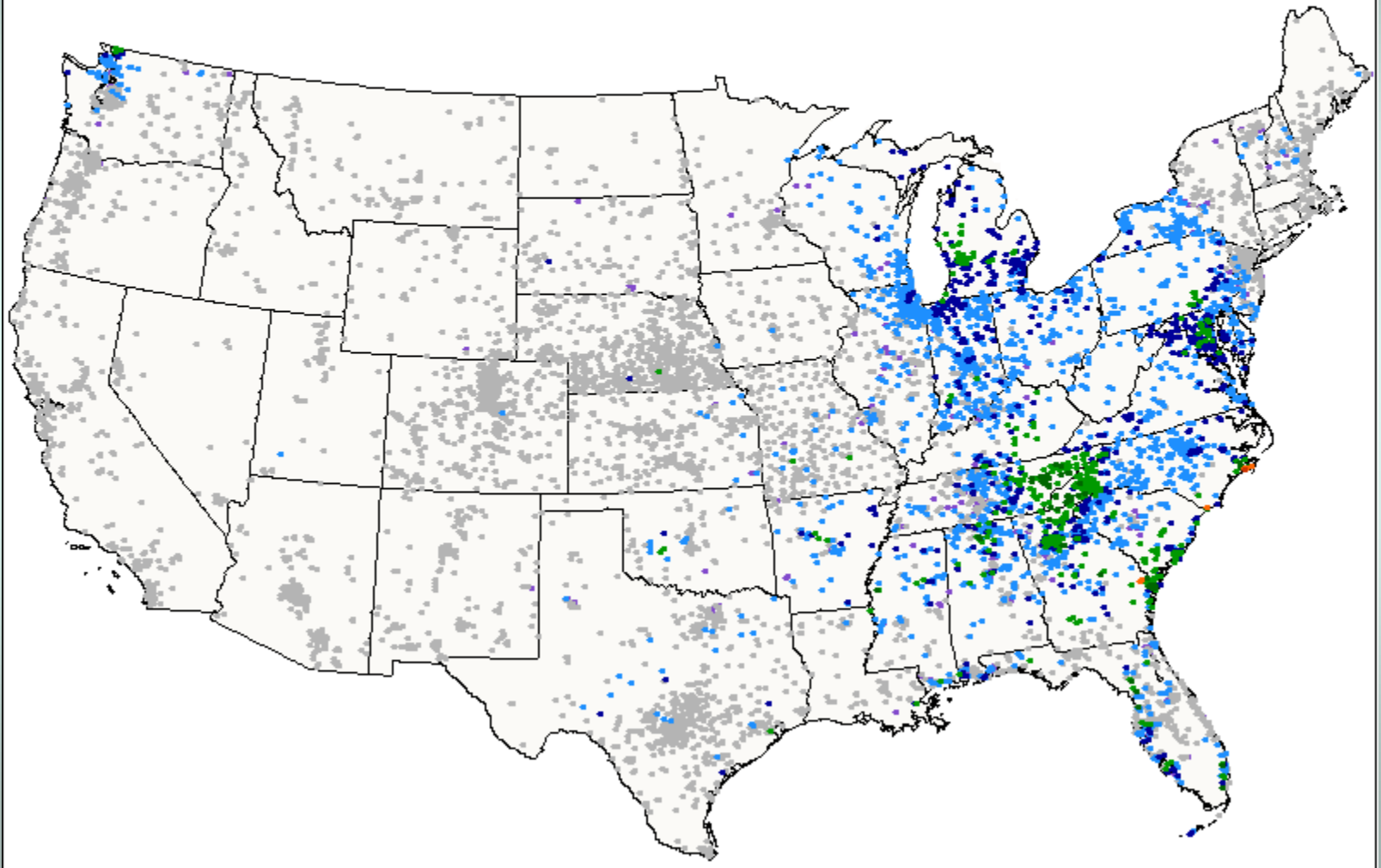


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2010	Standard	Get Map

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

USA 9/12/2010

0.0 | Trace | 0.01 - 0.30 | 0.31 - 0.60 | 0.61 - 1.50 | 1.51 - 3.59 | 3.60 - 5.38 | 5.39 - 5.98

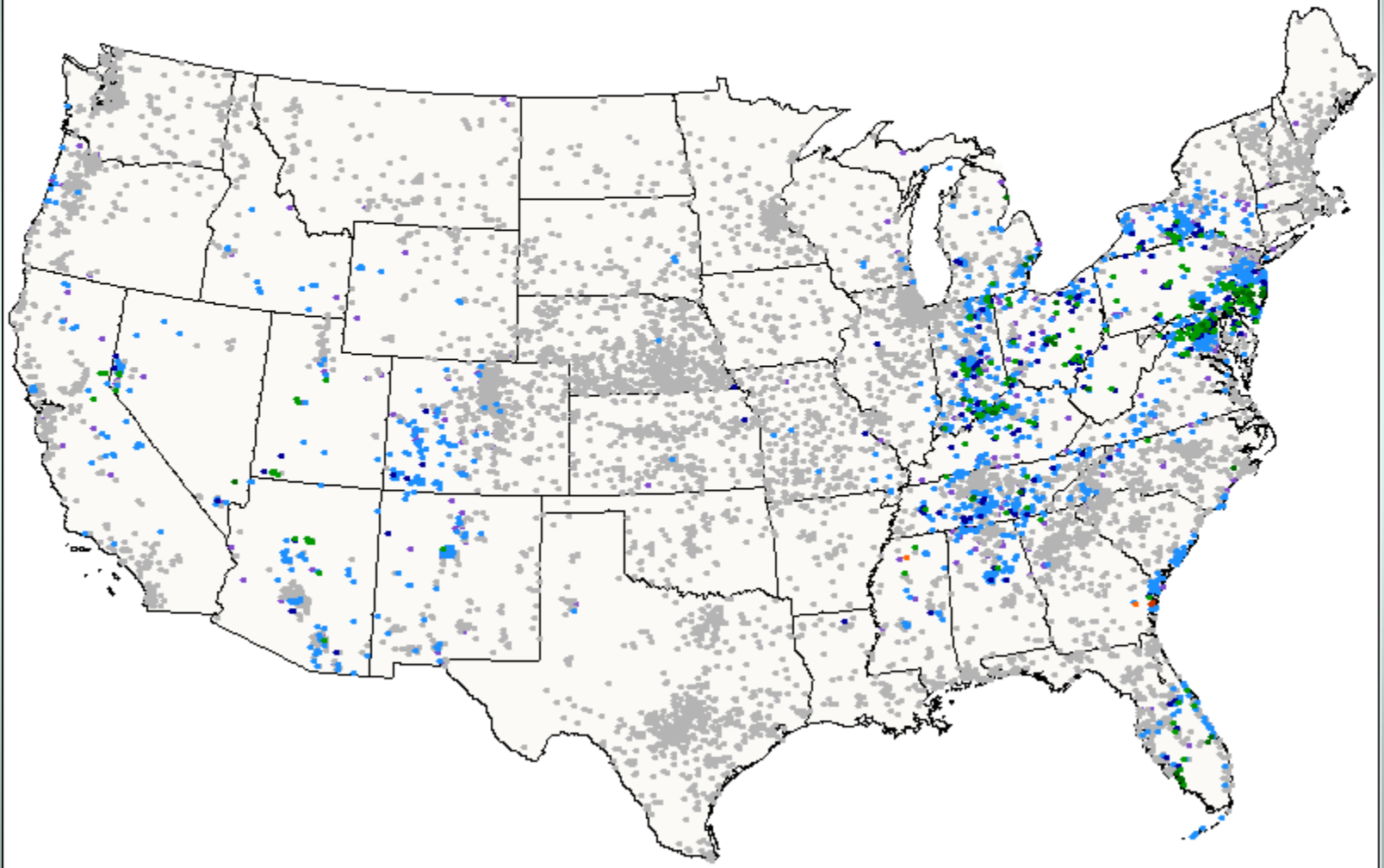


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2011	Standard	Get Map

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

USA 9/12/2011

0.0 | Trace | 0.01 - 0.18 | 0.19 - 0.36 | 0.37 - 0.91 | 0.92 - 2.19 | 2.20 - 3.29 | 3.30 - 3.67

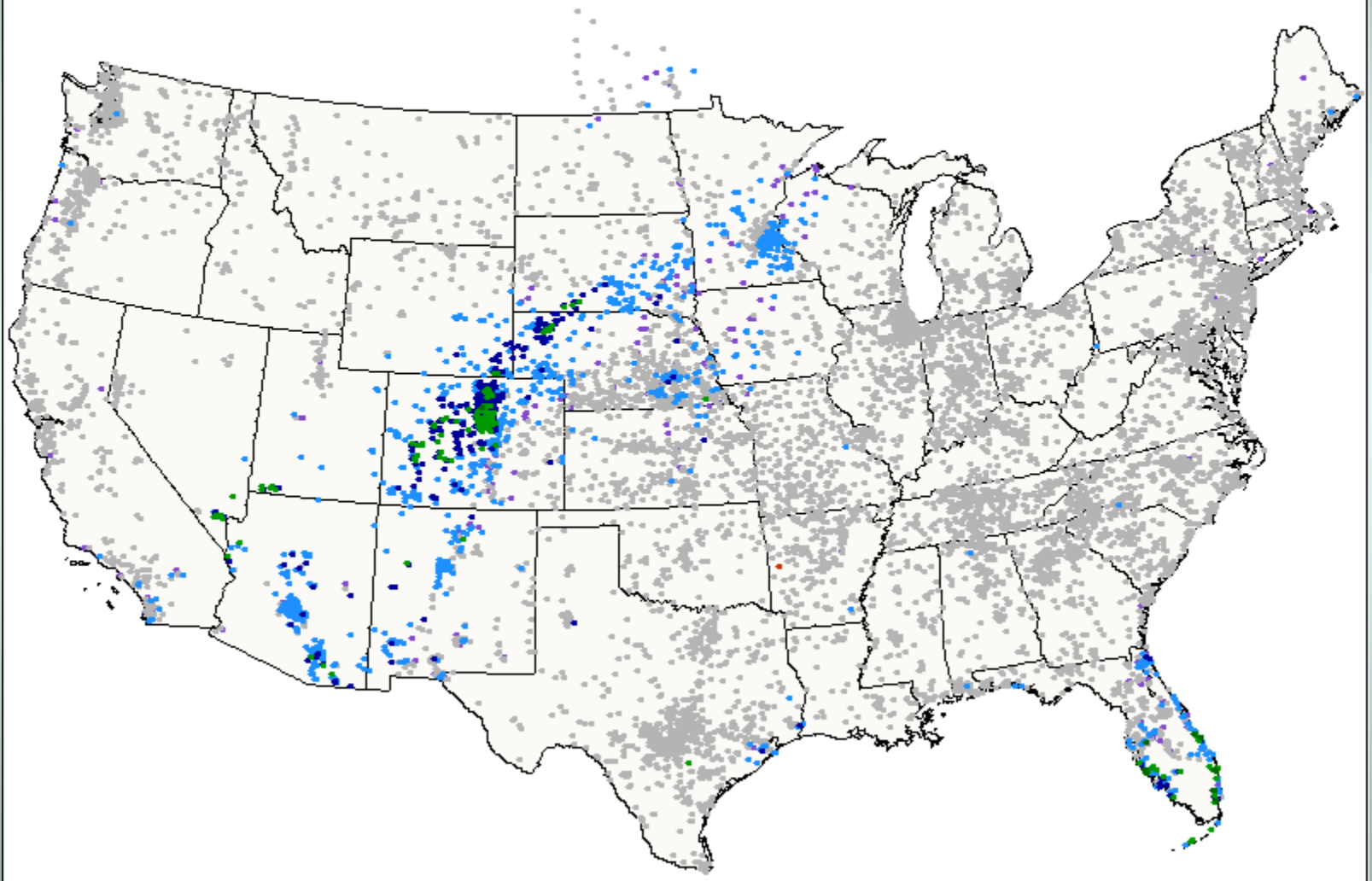


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2012	Standard	Get Map

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

USA 9/12/2012

0.0 | Trace | 0.01 - 0.30 | 0.31 - 0.60 | 0.61 - 1.50 | 1.51 - 3.60 | 3.61 - 5.40 | 5.41 - 6.00

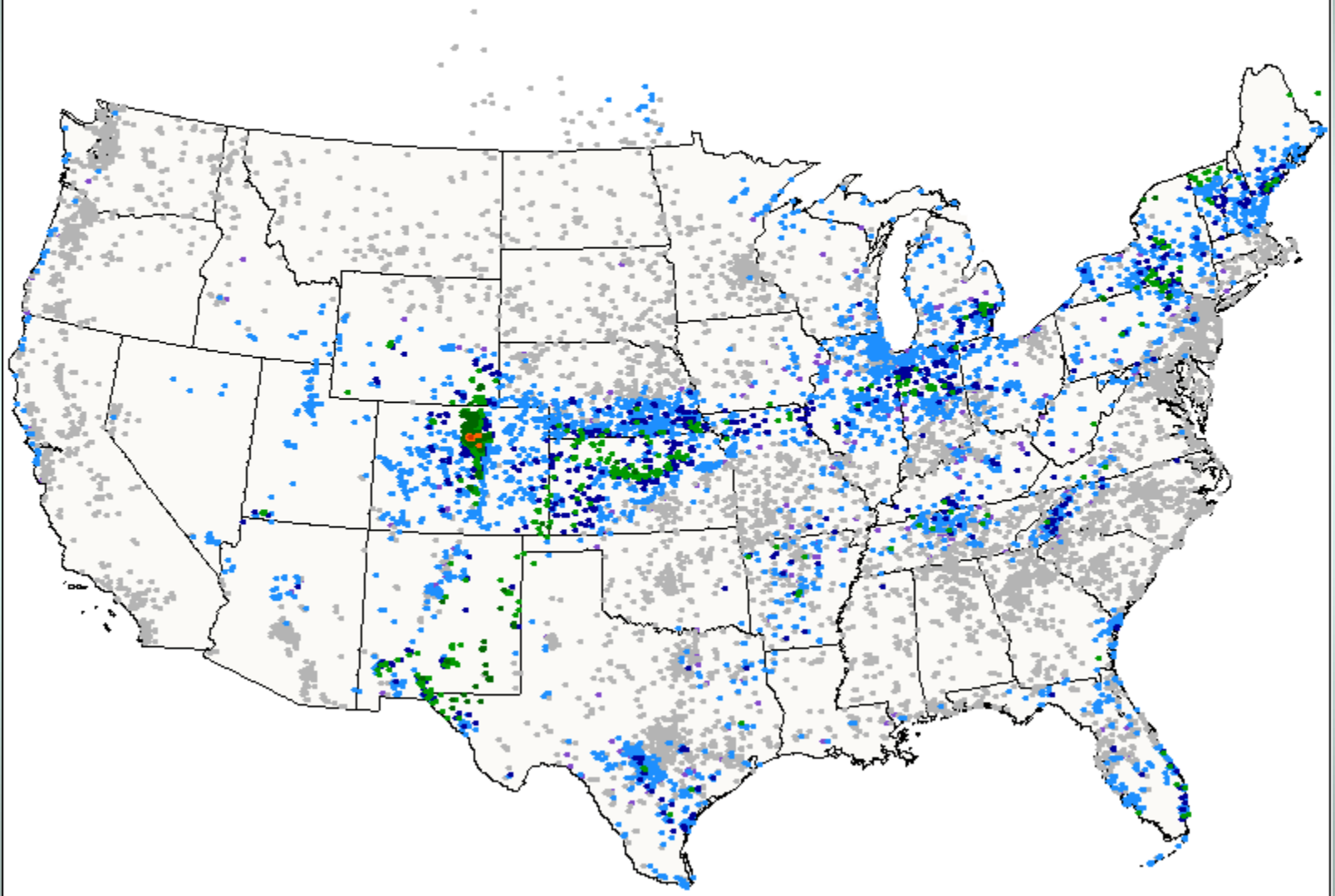


Map Type	Map Location		Date	Colors	
Precipitation	National	No State Selected	9/12/2013	Standard	Get Map

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

USA 9/12/2013

0.0 | Trace | 0.01 - 0.50 | 0.51 - 1.00 | 1.01 - 2.49 | 2.50 - 5.97 | 5.98 - 8.95 | 8.96 - 9.93



Join Us! Tell others!
We need rural observers
http://www.cocorahs.org

nental
Literacy Program and *many* local charter sponsors.

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.

Colorado Climate Center

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu

- Click on “Presentations”