"I need Weather and Climate Data"

Nolan Doesken

Colorado Climate Center

and

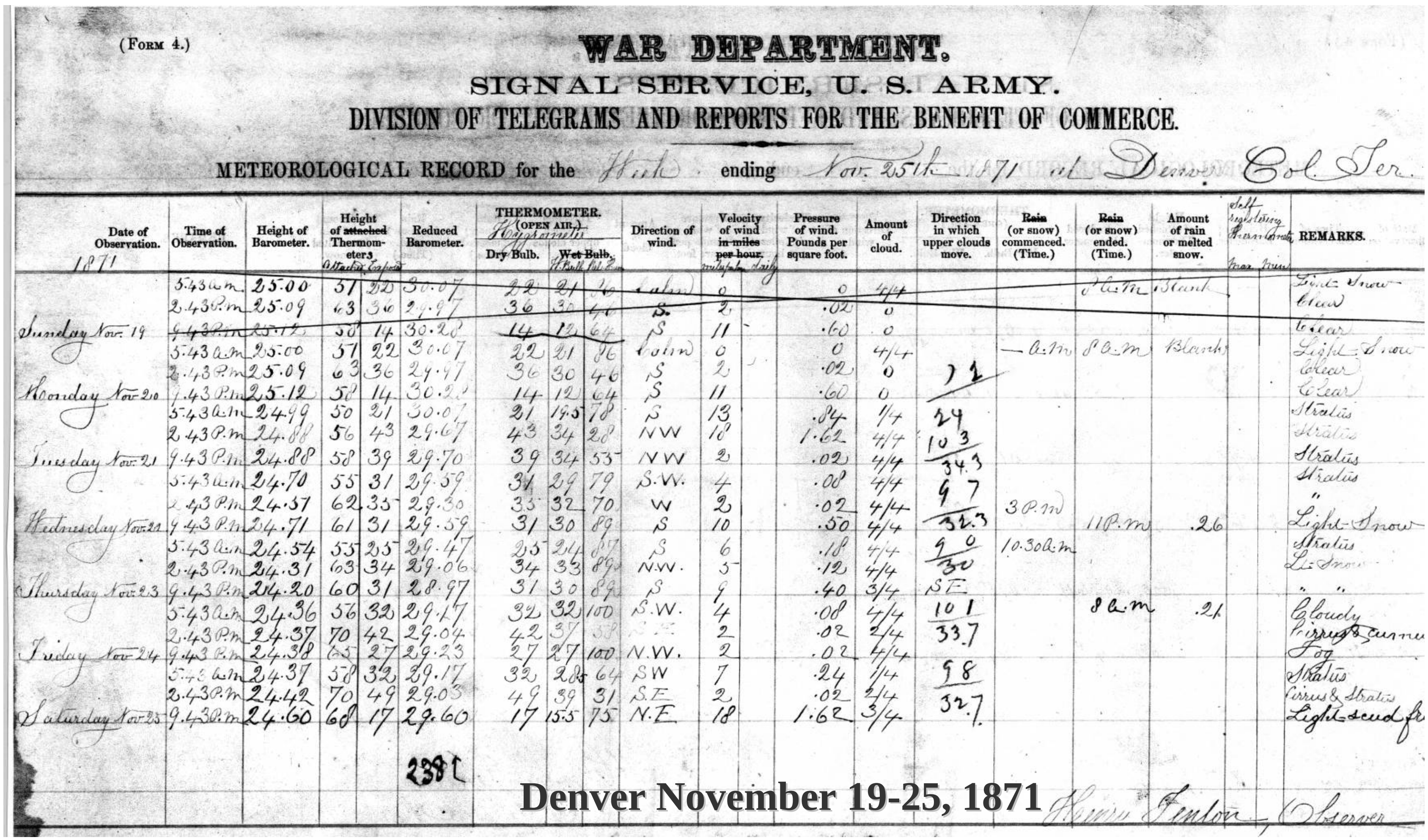
Robert Glancy

National Weather Service

Presented at Colorado Climate and Weather Seminar, Longmont, September 21, 2007

Prepared by Odie Bliss

Systematic weather data collection began in Colorado in the 1870s



(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.

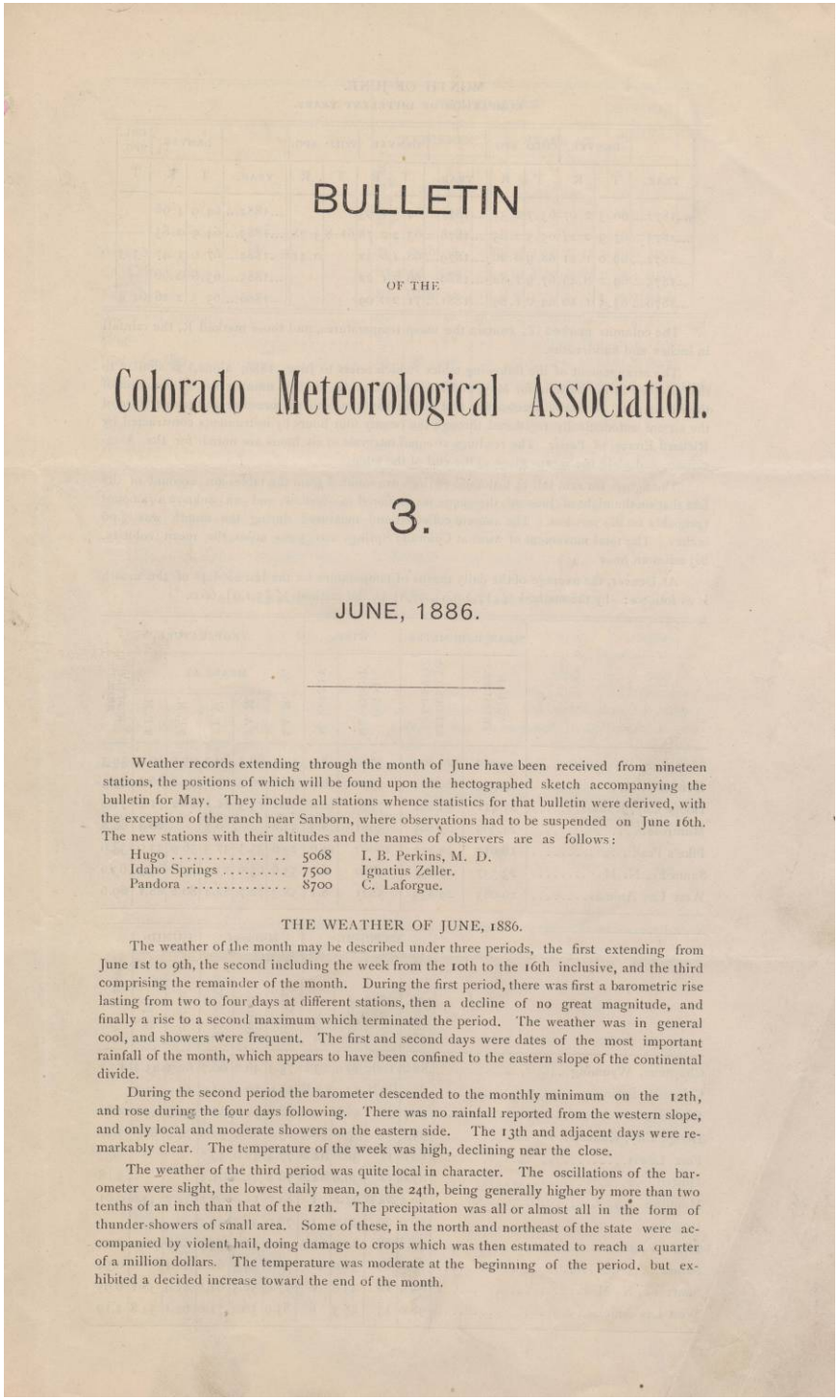
Date of Observation. 1871	Time of Observation.	Height of Barometer.	Height of Thermometers: Attached	Height of Thermometers: Exposed	Reduced Barometer.	Thermometer (Open air.) Hygrometer: Dry Bulb.	Wet Bulb	Rel. Hum.	Direction of wind.	Velocity of wind, miles per hour	Pressure of wind. Pounds per square 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 Therm.: Max.	Self registering Therm.: Min.	REMARKS.
	~~5.43 a.m~~	~~25.00~~	~~37~~	~~22~~	~~30.07~~	~~22~~	~~21~~	~~86~~	~~Calm~~	~~0~~	~~0~~	~~4/4~~			~~7 a.m~~	~~Blank~~			~~Light 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	11						Clear
Monday Nov 20	9.43 P.m	25.12	58	14	30.28	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	343						Stratus
	5.43 a.m	24.70	55	31	29.59	31	29	79	S.W.	4	.08	4/4							Stratus
	2.43 P.m	24.57	62	35	29.30	35	32	70	W	2	.02	4/4	97	3 P.m					"
Wednesday Nov 22	9.43 P.m	24.71	61	31	29.59	31	30	89	S	10	.50	4/4	323		11 P.m	.26			Light Snow
	5.43 a.m	24.54	55	25	29.47	25	24	87	S	6	.18	4/4	90	10.30 a.m					Stratus
	2.43 P.m	24.31	63	34	29.06	34	33	89	N.W.	5	.12	4/4	30						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	58	S.E.	2	.02	2/4	337						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	57	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							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	327						Light scud fr

238 l

Henry Fenton, Observer

Denver November 19-25, 1871

In the 1880s the Colorado legislature approved and funded the *"Colorado Meteorological Association"* to better monitor and document the climatic resources of our young state.



BULLETIN

OF THE

Colorado Meteorological Association.

3.

JUNE, 1886.

Weather records extending through the month of June have been received from nineteen stations, the positions of which will be found upon the hectographed sketch accompanying the bulletin for May. They include all stations whence statistics for that bulletin were derived, with the exception of the ranch near Sanborn, where observations had to be suspended on June 16th. The new stations with their altitudes and the names of observers are as follows:

Hugo	5068	I. B. Perkins, M. D.
Idaho Springs	7500	Ignatius Zeller.
Pandora	8700	C. Laforgue.

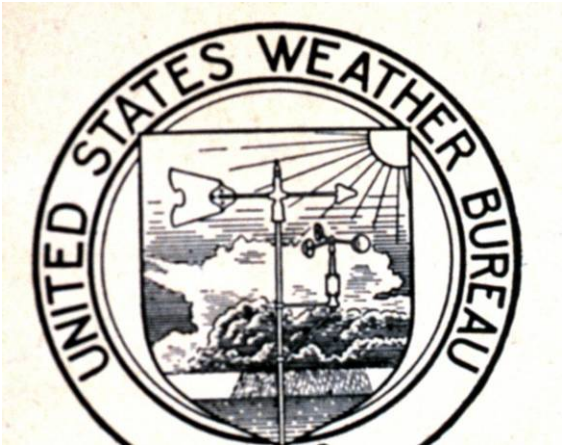
THE WEATHER OF JUNE, 1886.

The weather of the month may be described under three periods, the first extending from June 1st to 9th, the second including the week from the 10th to the 16th inclusive, and the third comprising the remainder of the month. During the first period, there was first a barometric rise lasting from two to four days at different stations, then a decline of no great magnitude, and finally a rise to a second maximum which terminated the period. The weather was in general cool, and showers were frequent. The first and second days were dates of the most important rainfall of the month, which appears to have been confined to the eastern slope of the continental divide.

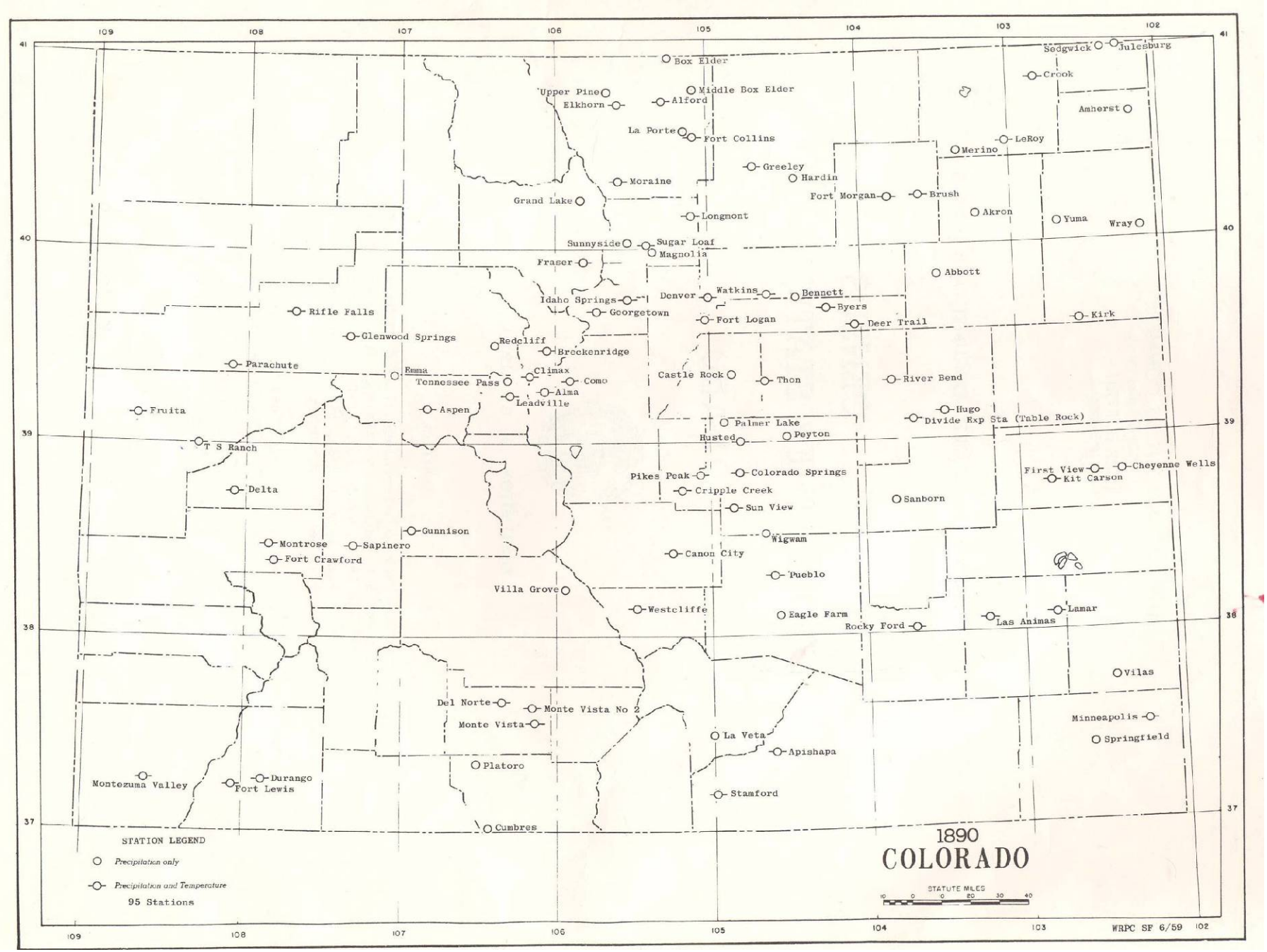
During the second period the barometer descended to the monthly minimum on the 12th, and rose during the four days following. There was no rainfall reported from the western slope, and only local and moderate showers on the eastern side. The 13th and adjacent days were remarkably clear. The temperature of the week was high, declining near the close.

The weather of the third period was quite local in character. The oscillations of the barometer were slight, the lowest daily mean, on the 24th, being generally higher by more than two tenths of an inch than that of the 12th. The precipitation was all or almost all in the form of thunder-showers of small area. Some of these, in the north and northeast of the state were accompanied by violent hail, doing damage to crops which was then estimated to reach a quarter of a million dollars. The temperature was moderate at the beginning of the period, but exhibited a decided increase toward the end of the month.

In 1890 the USDA took over the responsibilities of climate monitoring on a national level, and the first civilian weather service was formed –
the U.S. Weather Bureau



Colorado Weather Stations in 1890



In the 1930s growth of civilian aviation created a new need for timely weather observations

Airways Weather Observations

U.S. Department of Commerce
National Oceanic & Atmospheric Administration

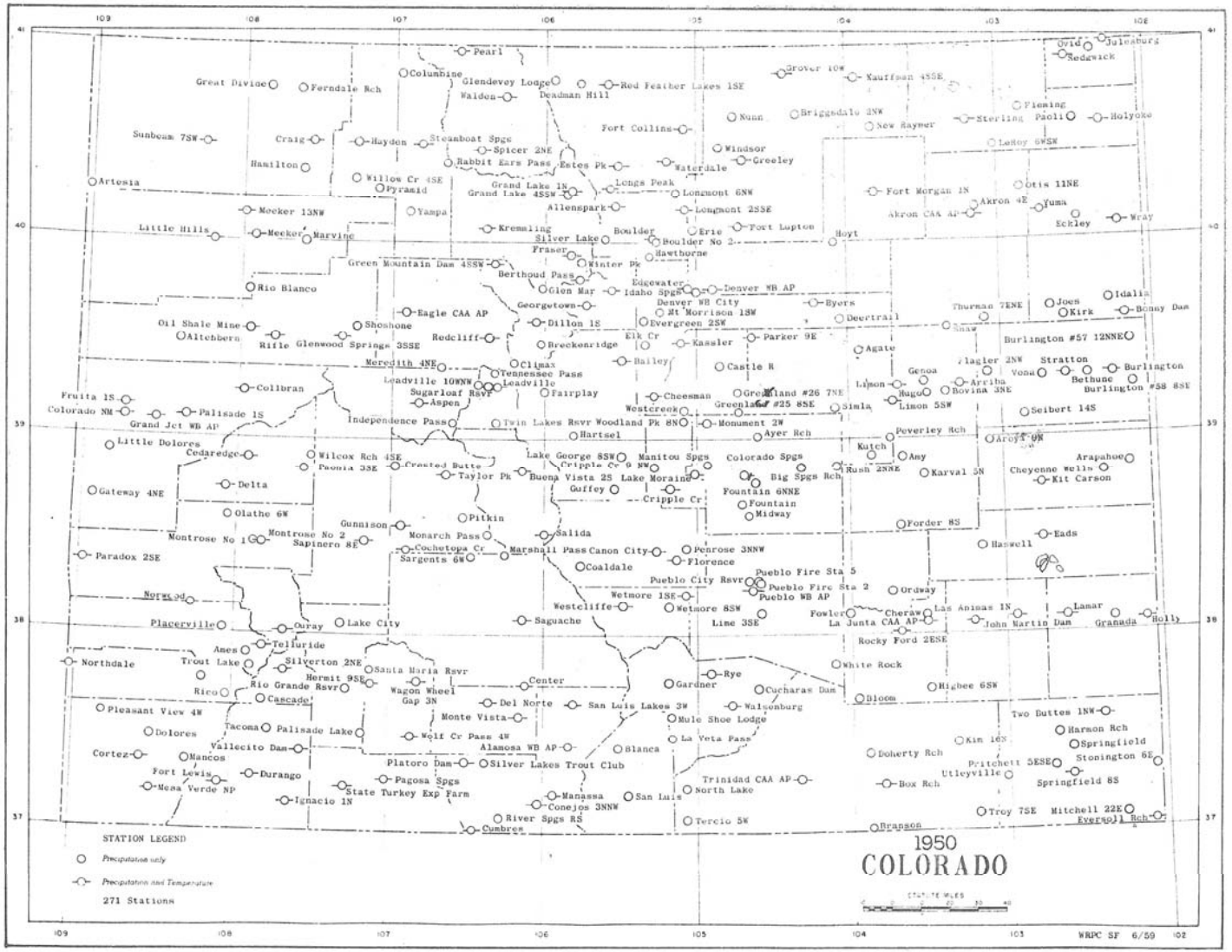
QUALITY CONTROLLED LOCAL CLIMATOLOGICAL DATA
(final)
HOURLY OBSERVATIONS TABLE
COLORADO PLAINS RGNL ARPT (24015)
AKRON , CO
(08/2007)

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville, North Carolina 28801

Elevation: 4676 ft. above sea level
Latitude: 40.172
Longitude: -103.232
Data Version: VER2

Date	Time (LST)	Station Type	Sky Conditions	Visibility (SM)	Weather Type	Dry Bulb Temp		Wet Bulb Temp		Dew Point Temp		Rel Humd %	Wind Speed (MPH)	Wind Dir	Wind Gusts (MPH)	Station Pressure (in. hg)	Press Tend	Net 3-hr Chg (mb)	Sea Level Pressure (in. hg)
						(F)	(C)	(F)	(C)	(F)	(C)								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
01	0053	12	FEW100	10.00		67	19.4	65	18.3	64	17.8	90	9	140		25.35			29.85
01	0153	12	CLR	9.00		64	17.8	63	17.0	62	16.7	93	3	120		25.35	6	006	29.85
01	0253	12	CLR	6.00	BR	63	17.2	62	16.8	62	16.7	97	6	110		25.35			29.84
01	0353	12	CLR	4.00	BR	63	17.2	62	16.5	61	16.1	93	6	110		25.35			29.83
01	0402	12	CLR	1.75	BR	63	17.0	62	16.5	61	16.0	93	5	090		25.35			M
01	0404	12	VV001	1.00	BR	63	17.0	62	16.5	61	16.0	93	3	100		25.34			M
01	0411	12	SCT001 SCT009	0.25	FG	61	16.0	61	16.1	61	16.0	100	3	090		25.34			M
01	0418	12	FEW001 BKN009	0.25	FG	61	16.0	61	16.1	61	16.0	100	5	090		25.34			M
01	0441	12	BKN001 OVC009	0.25	FG	63	17.0	62	16.5	61	16.0	93	5	120		25.35			M
01	0453	12	OVC001	0.00	FG	62	16.7	61	16.3	61	16.1	97	3	130		25.35	5	002	29.84
01	0553	12	VV001	0.00	FG	63	17.2	62	16.8	62	16.7	97	0	000		25.37			29.88
01	0636	12	BKN001 BKN006	1.25	BR	64	18.0	64	17.7	64	18.0	100	0	000		25.37			M
01	0638	12	BKN001 BKN006	2.00	BR	64	18.0	64	17.7	64	18.0	100	0	000		25.37			M
01	0642	12	SCT001 SCT006	4.00	BR	64	18.0	64	17.7	64	18.0	100	0	000		25.37			M
01	0653	12	FEW001	7.00		67	19.4	66	18.7	65	18.3	93	0	000		25.38			29.90
01	0753	12	CLR	10.00		74	23.3	68	19.9	65	18.3	74	3	030		25.40	1	017	29.91
01	0853	12	CLR	10.00		75	23.9	68	20.1	65	18.3	71	9	050		25.42			29.94
01	0953	12	CLR	10.00		77	25.0	68	20.1	64	17.8	64	8	080		25.42			29.95
01	1053	12	CLR	10.00		82	27.8	69	20.6	63	17.2	53	10	090		25.43	1	012	29.94
01	1153	12	CLR	10.00		84	28.9	68	20.0	60	15.6	44	13	090	18	25.43			29.94
01	1253	12	CLR	10.00		87	30.6	67	19.3	56	13.3	35	14	060	20	25.42			29.93
01	1353	12	CLR	10.00		88	31.1	65	18.4	52	11.1	29	13	070	24	25.41	8	008	29.91
01	1453	12	CLR	10.00		89	31.7	64	17.8	49	9.4	25	17	070	23	25.40			29.91
01	1553	12	CLR	10.00		88	31.1	66	18.9	54	12.2	31	15	050	21	25.40			29.91
01	1653	12	CLR	10.00		83	28.3	67	19.2	58	14.4	43	17	050		25.42	3	004	29.94
01	1753	12	FEW050 SCT065	6.00	HZ	73	22.8	65	18.4	61	16.1	66	28	050	39	25.47			30.02
01	1853	12	CLR	10.00		70	21.1	62	16.9	58	14.4	66	14	060		25.47			30.01
01	1953	12	CLR	10.00		68	20.0	62	16.5	58	14.4	71	8	080		25.49	1	023	30.03
01	2053	12	CLR	10.00		68	20.0	62	16.5	58	14.4	71	6	140		25.48			30.03
01	2153	12	CLR	10.00		67	19.4	63	16.9	60	15.6	78	5	360		25.50			30.04
01	2253	12	CLR	10.00		67	19.4	63	16.9	60	15.6	78	6	010		25.54	3	014	30.06

The US Weather Bureau was transferred to the Department of Commerce in the 1940s



The U.S. Weather Bureau/National Weather Service has faithfully maintained an oft taken for granted network of weather stations in Colorado and across the country – the Cooperative Observer Network

Photo by Christopher Davey

The NWS stations remain the backbone network for long-term climate monitoring

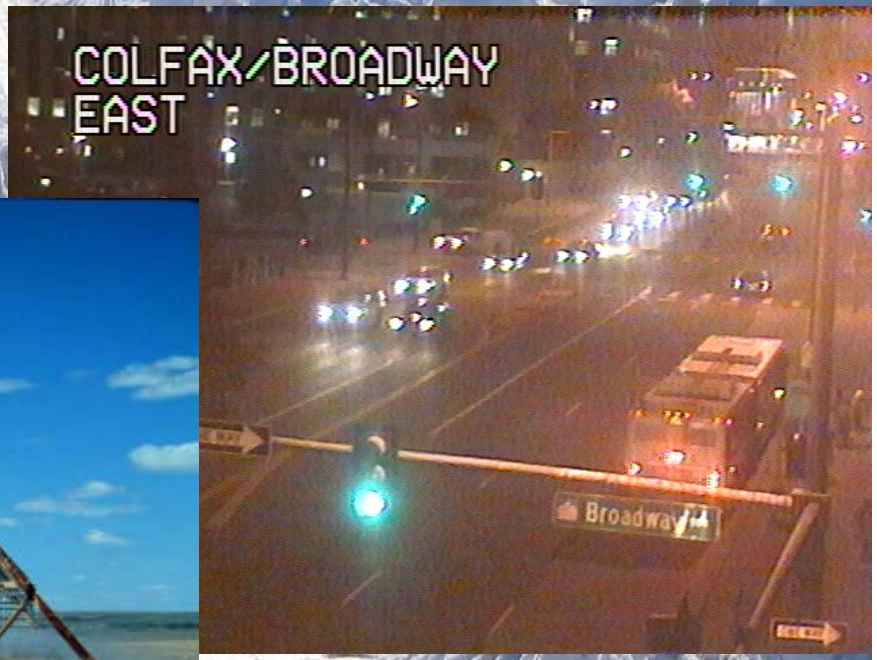
From Kelly Redmond, WRCC

Approximately 5000 daily max/min temperature stations, 8000 daily precipitation stations, 3000 automated hourly precipitation stations.

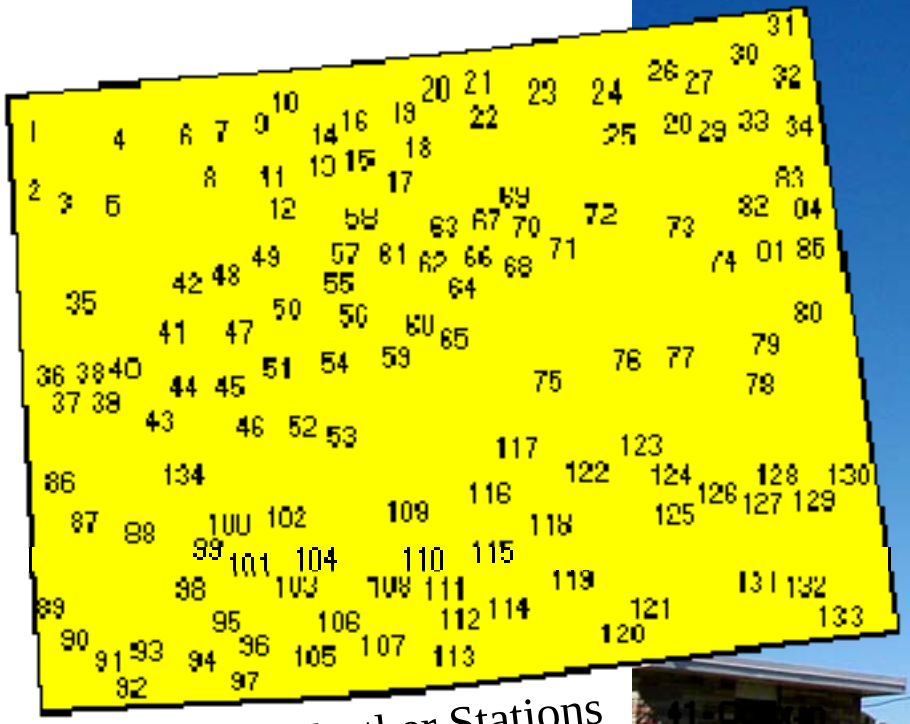
Automation of some weather observations began in the 1970s

As a result of automation, many other organizations have gotten involved in weather measurements

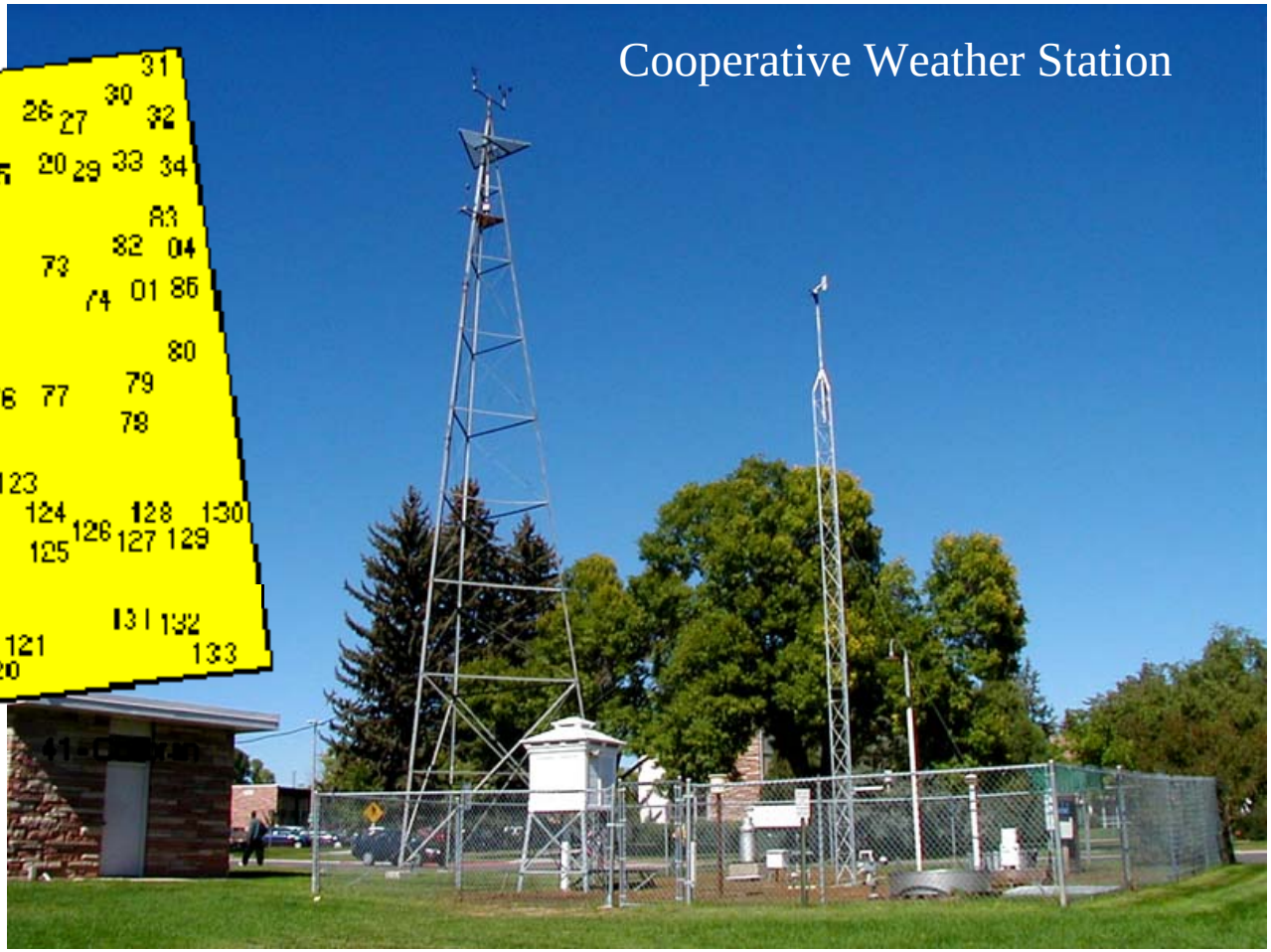
Weather data are important for many and varied applications



National Weather Service Cooperative Weather Stations



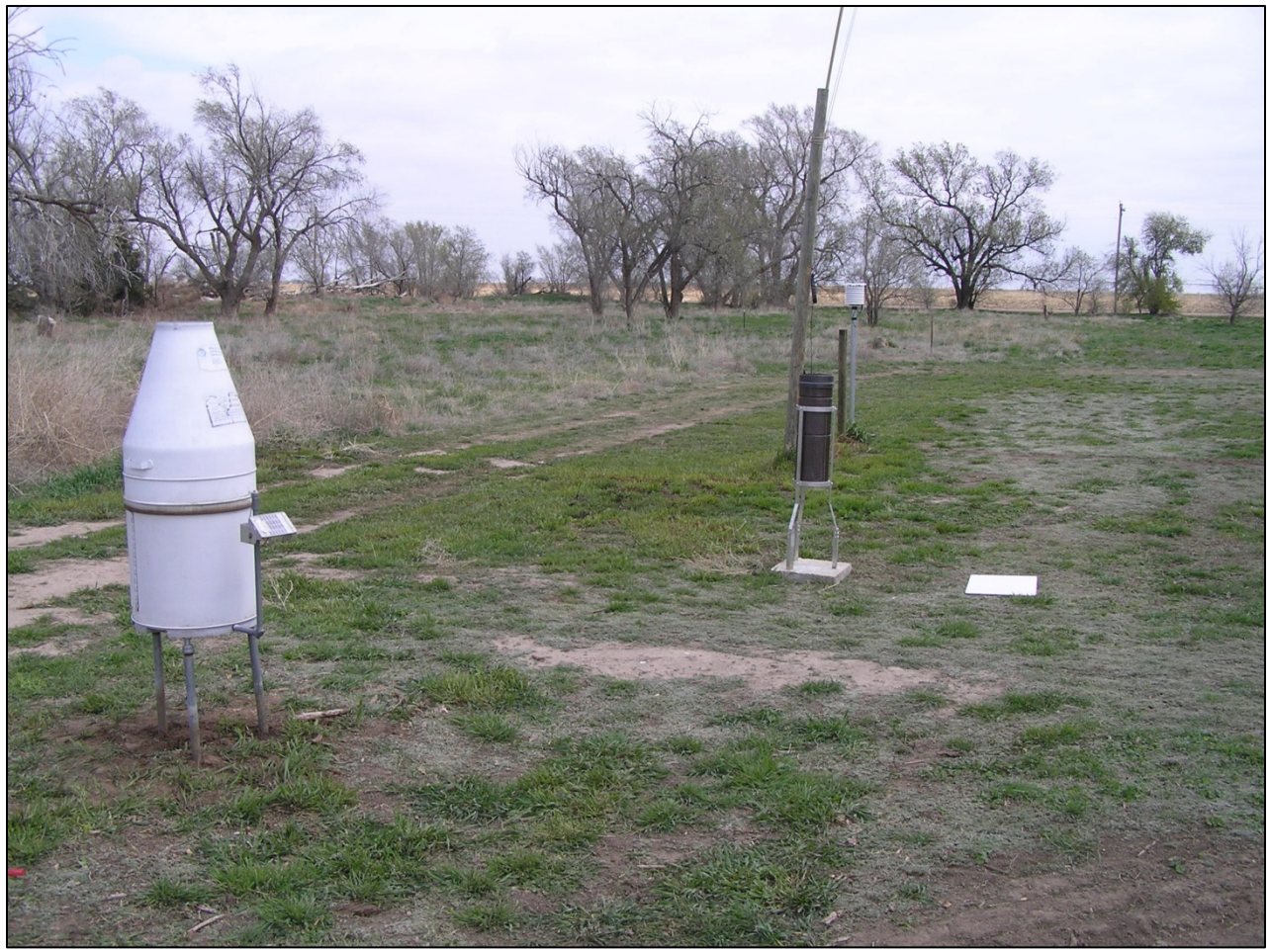
Cooperative Weather Stations in Colorado



Cooperative Weather Station

http://www.wrcc.dri.edu/summary/Climsmco.html

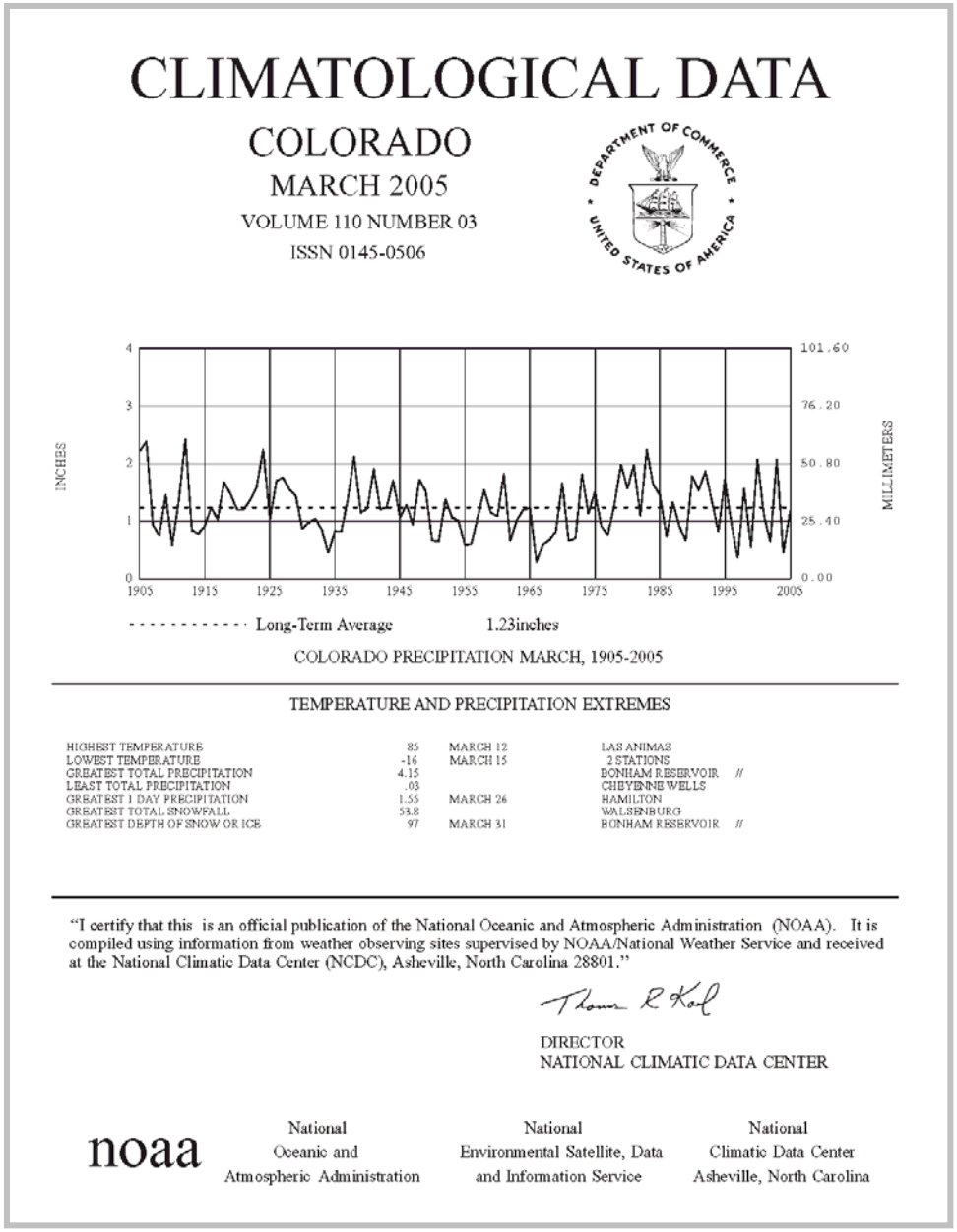
Holyoke NWS Cooperative Site



Award ceremony (9/19/07) to Sedgwick 4SE cooperative observer – Congratulations on 60 years of observations!

Layton Munson (center)

NCDC's *Climatological Data* publication for Colorado



CLIMATOLOGICAL DATA

COLORADO

MARCH 2005

VOLUME 110 NUMBER 03

ISSN 0145-0506

COLORADO PRECIPITATION MARCH, 1905-2005

TEMPERATURE AND PRECIPITATION EXTREMES

HIGHEST TEMPERATURE	85	MARCH 12	LAS ANIMAS
LOWEST TEMPERATURE	-16	MARCH 15	2 STATIONS
GREATEST TOTAL PRECIPITATION	4.15		BONHAM RESERVOIR //
LEAST TOTAL PRECIPITATION	.03		CHEYENNE WELLS
GREATEST 1 DAY PRECIPITATION	1.55	MARCH 26	HAMILTON
GREATEST TOTAL SNOWFALL	58.8		WALSENBURG
GREATEST DEPTH OF SNOW OR ICE	97	MARCH 31	BONHAM RESERVOIR //

"I certify that this is an official publication of the National Oceanic and Atmospheric Administration (NOAA). It is compiled using information from weather observing sites supervised by NOAA/National Weather Service and received at the National Climatic Data Center (NCDC), Asheville, North Carolina 28801."

Thomas R Karl

DIRECTOR
NATIONAL CLIMATIC DATA CENTER

noaa

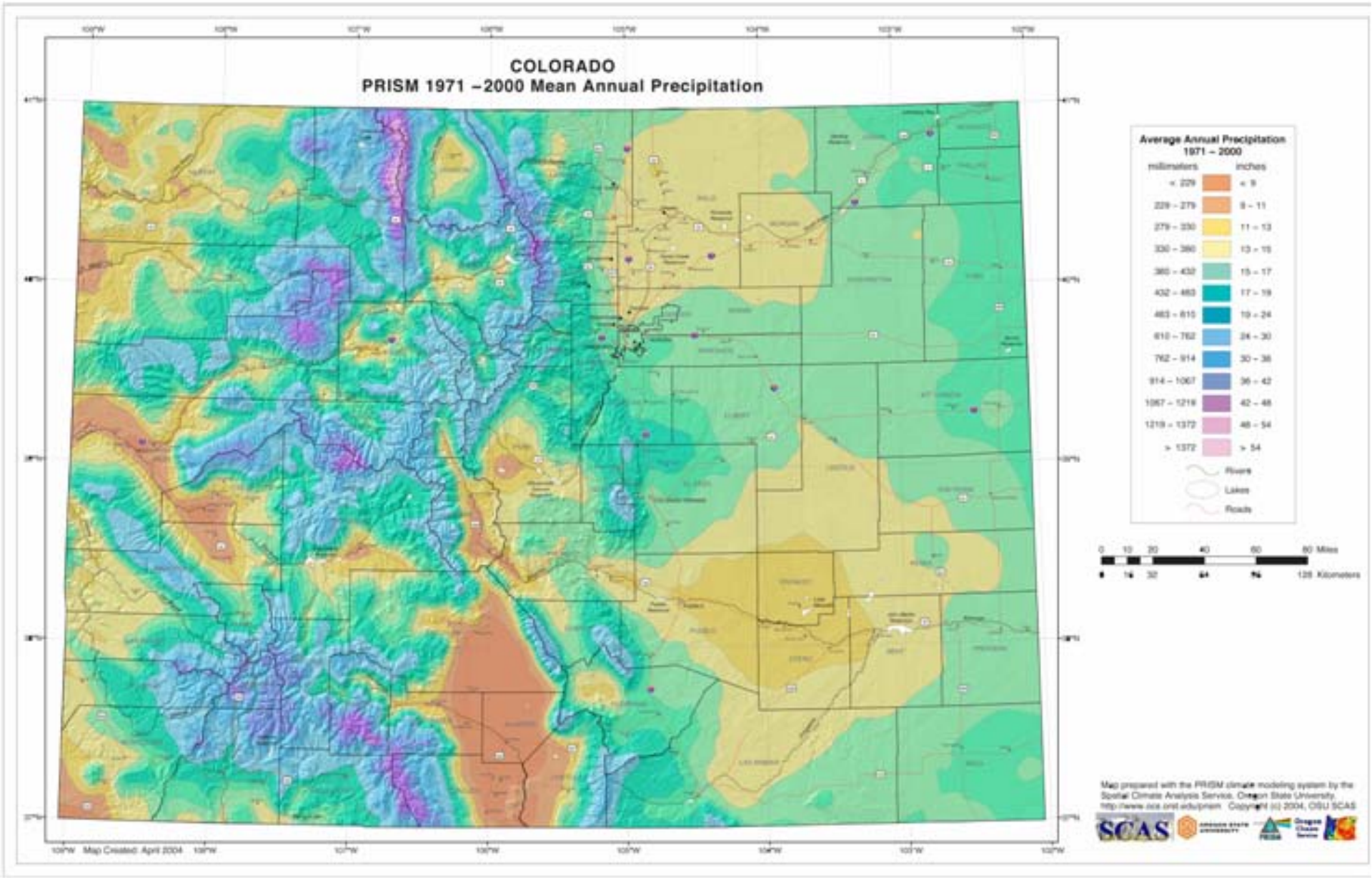
National Oceanic and Atmospheric Administration

National Environmental Satellite, Data and Information Service

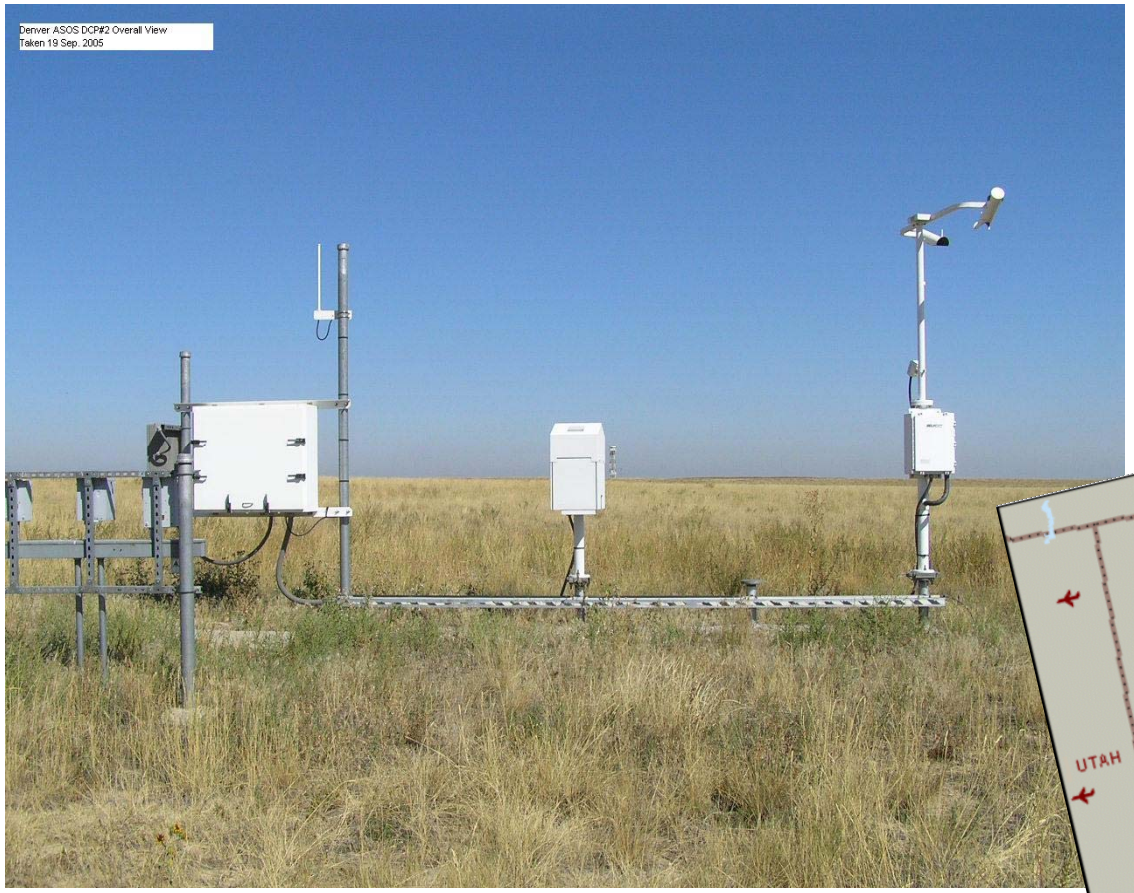
National Climatic Data Center Asheville, North Carolina

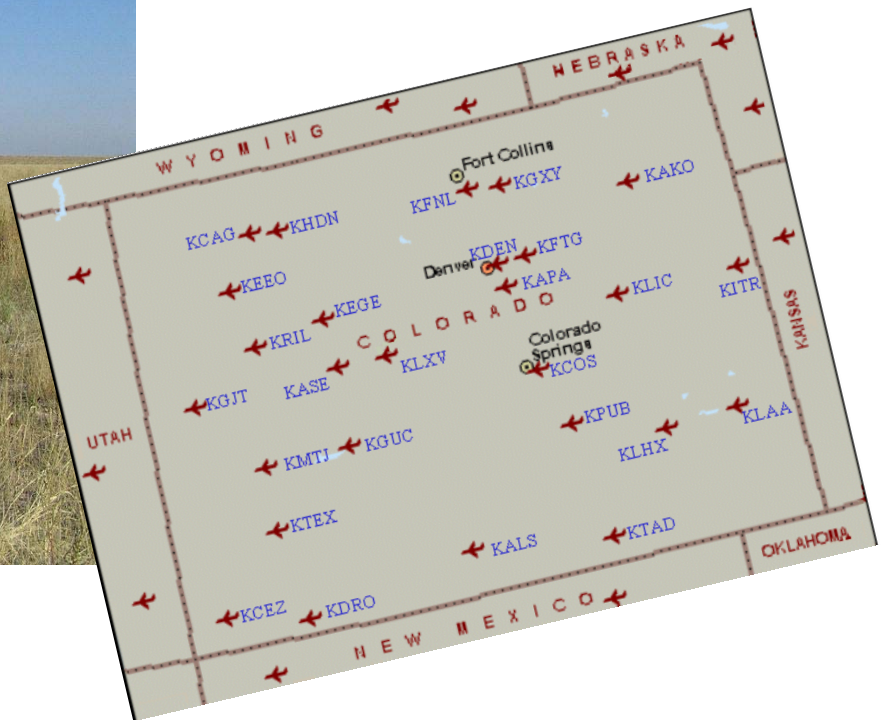
http://www7.ncdc.noaa.gov/IPS/

Colorado Average Annual Precipitation Map



National Weather Service Automated Surface Observing System (ASOS)





Denver International Airport ASOS,
Photo courtesy of the National Weather Service

Example F-6 form from Denver Intl Airport for July 2005

http://www.crh.noaa.gov/den

Preliminary Local Climatological Data (WS Form: F-6)...CORRECTED COOLING DEGREE DATA

Station: DENVER INTERNATIONAL AIRPORT Month: JULY Year: 2005

39.52N = Latitude 104.40W = Longitude Gnd Elev. 5431 ft Std Time: MDT

	Temperature in Fahrenheit							:Precip :	Snow		:Wind :	Fastest 2-Min Columns		Sunshine :		Sky		:Peak Wind	
-1- Day	-2- Max	-3- Min	-4- Avg	-5- Dep.	-6a- HDD	-6b- CDD	-7- Water	-8- Snow	-9- Depth	-10- Avg.	-11- Speed	-12- Dir	-13- Mins.	-14- %PSBL	-15- SR-SS	-16- Weather	-17- Speed	-18- Dir
1	91	52	72	0	0	7	0.00	M	M	9.2	23	270	698	78%		3	30	260
2	96	62	79	7	0	14	0.00	M	M	10.6	25	10	734	82%		3	30	10
3	90	55	73	1	0	8	T	M	M	10.9	41	260	561	63%			53	260
4	87	50	69	-3	0	4	0.00	M	M	9.5	32	20	787	88%			38	20
5	90	53	72	0	0	7	0.00	M	M	10.4	25	150	707	79%			32	170
6	94	54	74	2	0	9	0.00	M	M	8.3	23	190	780	87%			28	200
7	97	66	82	9	0	17	0.00	M	M	12.9	24	200	773	87%			30	190
8	97	70	84	11	0	19	T	M	M	11.5	26	190	598	67%		3	39	150
9	97	60	79	6	0	14	T	M	M	10.8	41	80	767	86%		3	54	70
10	98	58	78	5	0	13	0.00	M	M	10.4	24	330	804	91%			29	320
11	96	60	78	5	0	13	0.00	M	M	6.7	21	50	743	84%		8	24	40
12	95	64	80	7	0	15	0.00	M	M	10.8	23	100	761	86%			25	90
13	95	64	80	7	0	15	0.00	M	M	9.0	18	180	771	87%			23	180
14	98	65	82	8	0	17	0.00	M	M	11.7	26	310	651	74%			32	320
15	95	64	80	6	0	15	0.00	M	M	11.1	32	190	618	70%		3	36	190
16	102	61	82	8	0	17	0.00	M	M	9.8	21	210	745	85%			25	210
17	86	61	74	0	0	9	0.00	M	M	12.3	24	50	632	72%			28	30
18	89	55	72	-2	0	7	0.00	M	M	12.7	22	160	708	81%			32	140
19	101	65	83	9	0	18	0.00	M	M	11.2	17	10	811	92%			25	20
20	105	68	87	13	0	22	0.00	M	M	9.8	26	30	702	80%			31	30
21	104	67	86	12	0	21	0.00	M	M	12.2	24	30	793	91%			30	30
22	102	68	85	11	0	20	0.00	M	M	10.9	24	150	802	92%			32	130
23	102	63	83	9	0	18	0.09	M	M	10.7	33	300	651	75%		3	41	300
24	92	64	78	4	0	13	0.04	M	M	9.5	32	230	579	67%		3	37	240
25	88	59	74	0	0	9	0.06	M	M	11.0	35	330	625	72%		1	39	330
26	68	56	62	-12	3	0	0.08	M	M	9.1	22	50	470	54%		1,2	24	50
27	86	54	70	-4	0	5	0.00	M	M	8.2	22	200	814	94%		2,1	25	200
28	95	52	74	0	0	9	0.00	M	M	9.3	22	200	821	95%			25	200
29	99	67	83	9	0	18	0.00	M	M	11.1	25	200	821	95%			39	200
30	101	68	85	11	0	20	0.00	M	M	11.7	31	120	737	86%			38	110
31	94	60	77	3	0	12	0.00	M	M	8.2	30	200	678	79%			36	200
Sum	2930	1885			3	405	0.27	0.0	0	321.5			22142					
Avg	94.5	60.8								10.4	Fast 41	Dir 80	27263	81%			Max 54	Dir. 70

NOTE: SNOWFALL AND SUNSHINE DATA MEASURED BY COOP OBSERVERS AT THE FORMER STAPLETON INTERNATIONAL AIRPORT.

[Temperature Data]

Average Monthly: 77.7
Departure from Normal: +4.3
Highest: 105 on 20
Lowest: 50 on 4

Records:
8-Rec high min 70 old 68 last 1989
16-Rec high 102 old 101 last 2003
19-Rec high 101 old 100 last 1934
20-Rec high 105 old 102 last 1939 (Ties Denver's hottest temperature ever)
21-Rec high 104 old 100 last 1981
22-Rec high 102 old 100 last 1931
23-Rec high 102 old 101 last 1910
29-Tied Rec high 99 last 1995
30-Rec high 101 old 100 last 1972 (Most 100 degree days in a month or season)
July 2005 2nd hottest and 3rd driest

[No. days with]

Max 32 or below: 0
Max 90 or above: 25
Min 32 or below: 0
Min 0 or below: 0

[Heating Degree Days (Base 65)]

Total this month: 3
Departure from Normal: +2
Seasonal Total: 3
Departure from Normal: +2

[Precipitation Data]

Total for Month: 0.27
Departure from Normal: -1.89
Greatest in 24 hrs: 0.14 on 25-26

SNOWFALL, ICE PELLETS, HAIL
Total for month: 0.0 inches
Greatest snowfall in 24 hrs: N on N
Greatest snow depth: 0 on 1

[WEATHER -No. days with]

0.01 inch or more precip: 4
0.10 inch or more precip: 0
0.50 inch or more precip: 0
1.00 inch or more precip: 0

[Cooling Degree Days (Base 65)]

Total this Month: 405
Departure from Normal: +136
Seasonal Total: 558
Departure from Normal: -136

Symbols used in column 16

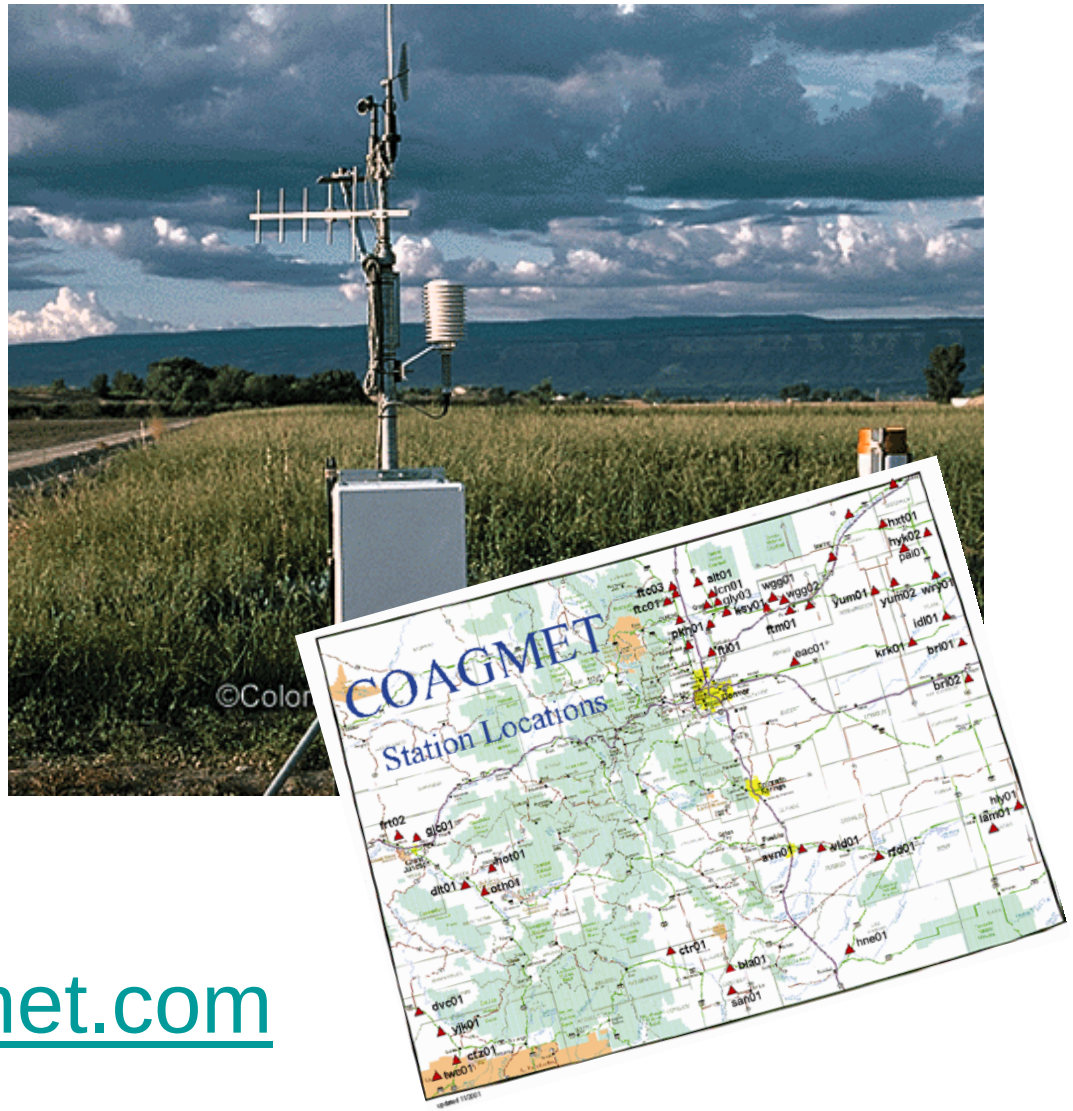
1 = Fog
2 = Fog reducing visibility to 1/4 mile or less
3 = Thunder
4 = Ice Pellets
5 = Hail
6 = Glaze or Rime
7 = Blowing dust or sand reducing visibility to 1/2 mile or less
8 = Smoke or haze
9 = Blowing snow
X = Tornado

[Pressure Data]

Highest Sea-Level 30.25 on 26
Lowest Sea-Level 29.61 on 2

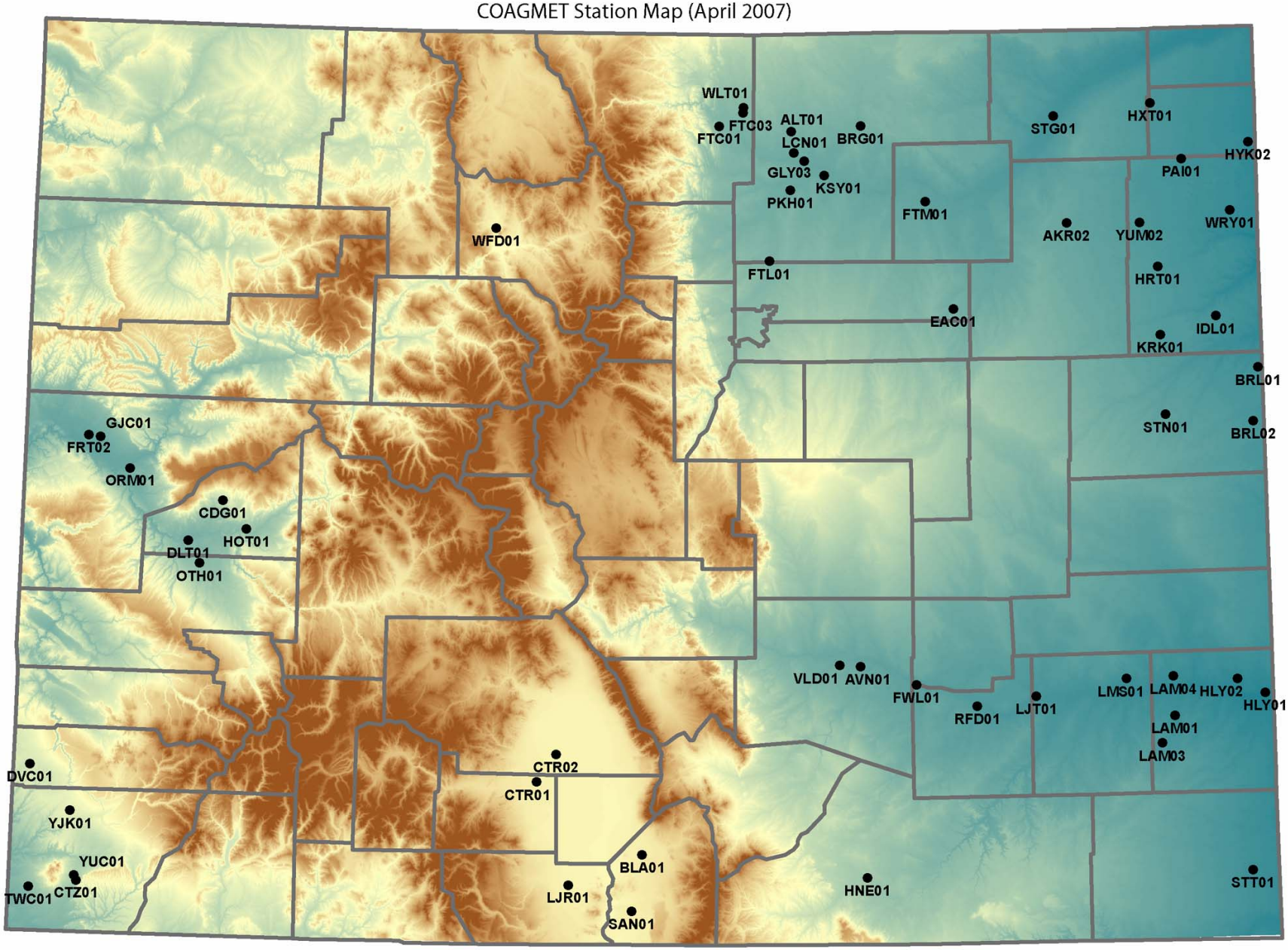
CoAgMet
Weather Data for Agriculture

- Automated weather stations with daily and hourly readings of:
  - Temperature
  - Humidity
  - Wind
  - Precipitation
  - Solar energy
  - Evapotranspiration



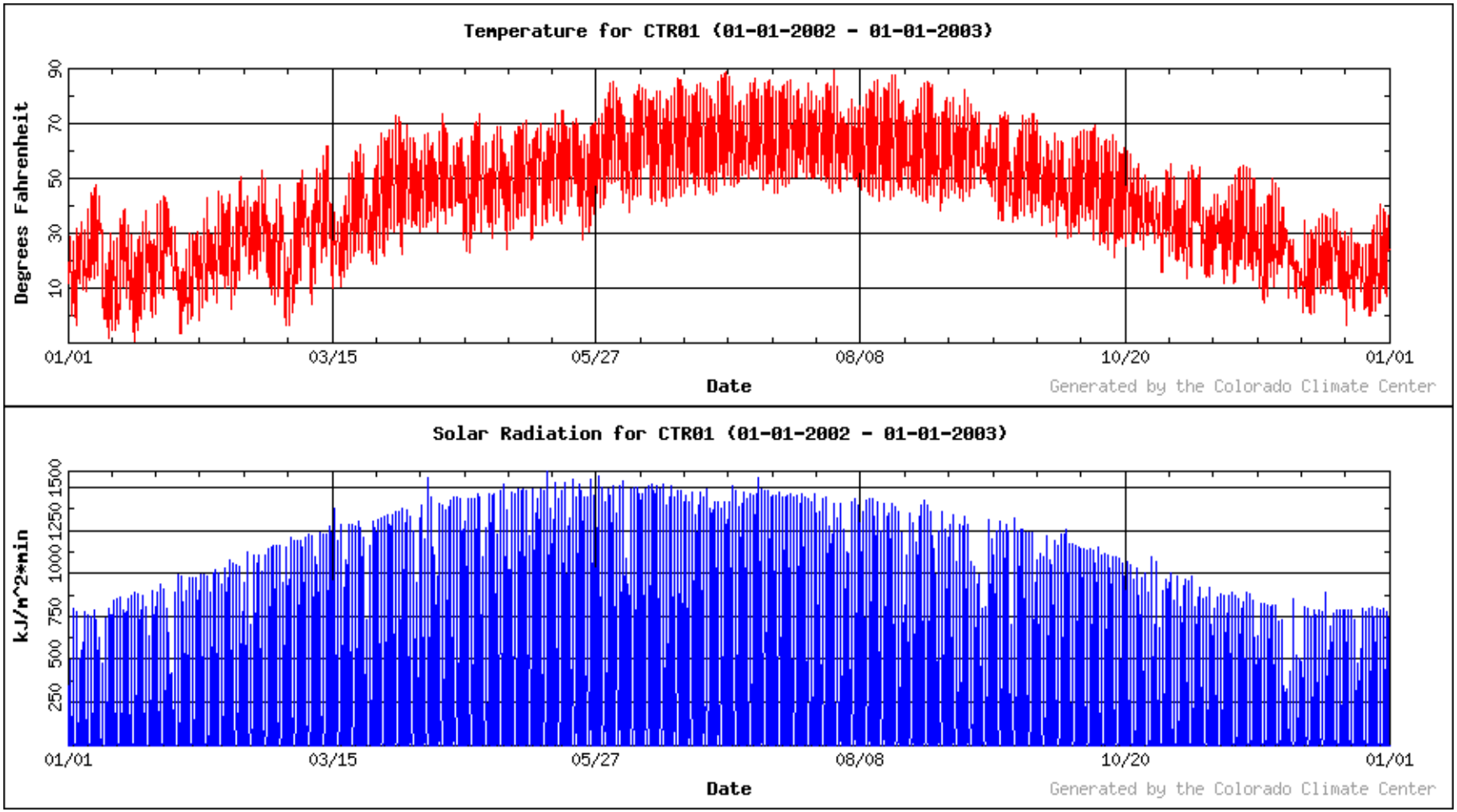
http://www.coagmet.com

COAGMET Station Map (April 2007)



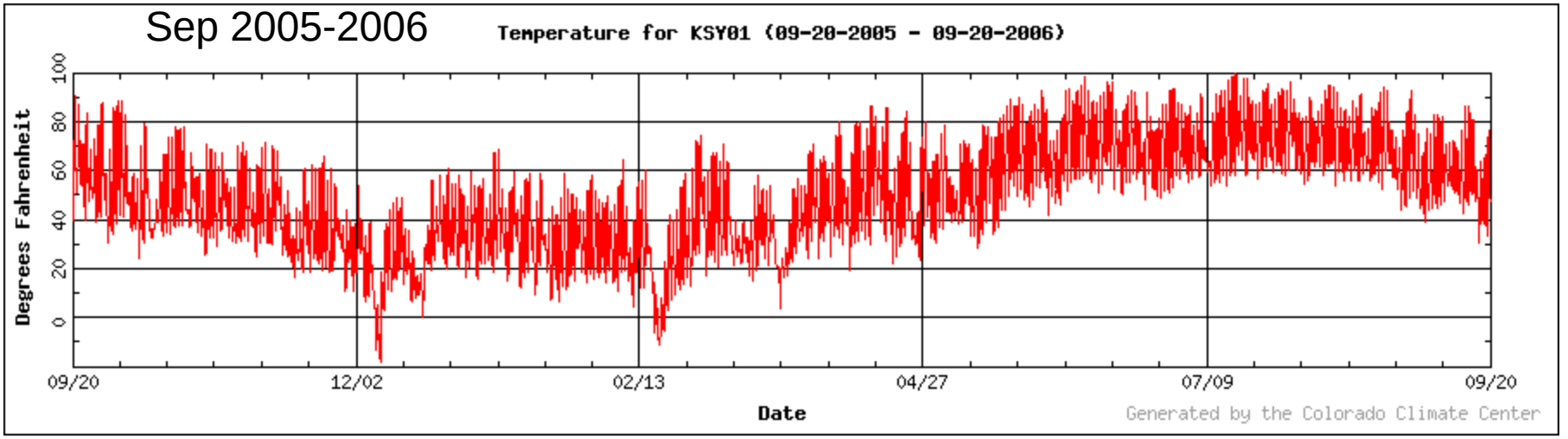
COLORADO

Center, Colo., CoAgMet Daily Values of Temperature and Solar Radiation

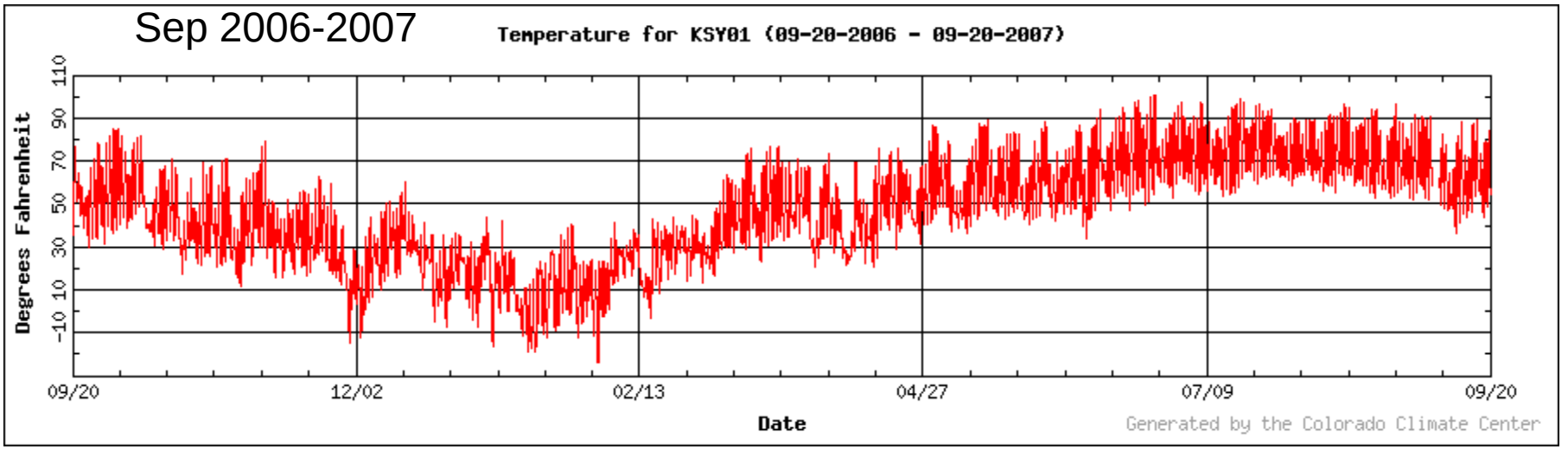


Kersey CoAgMet Temperature

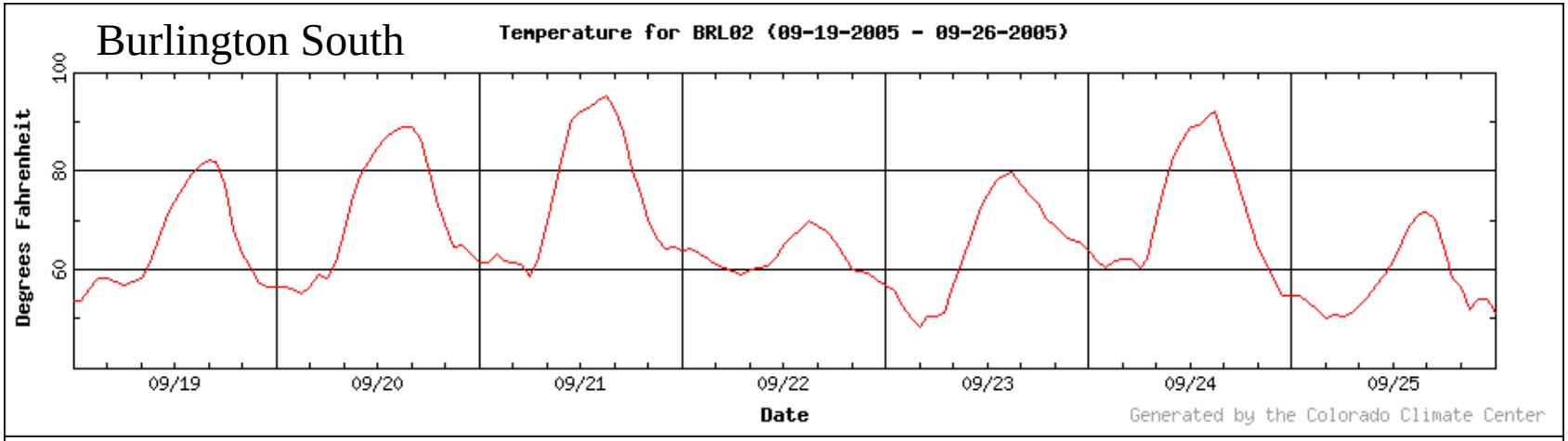
Sep 2005-2006

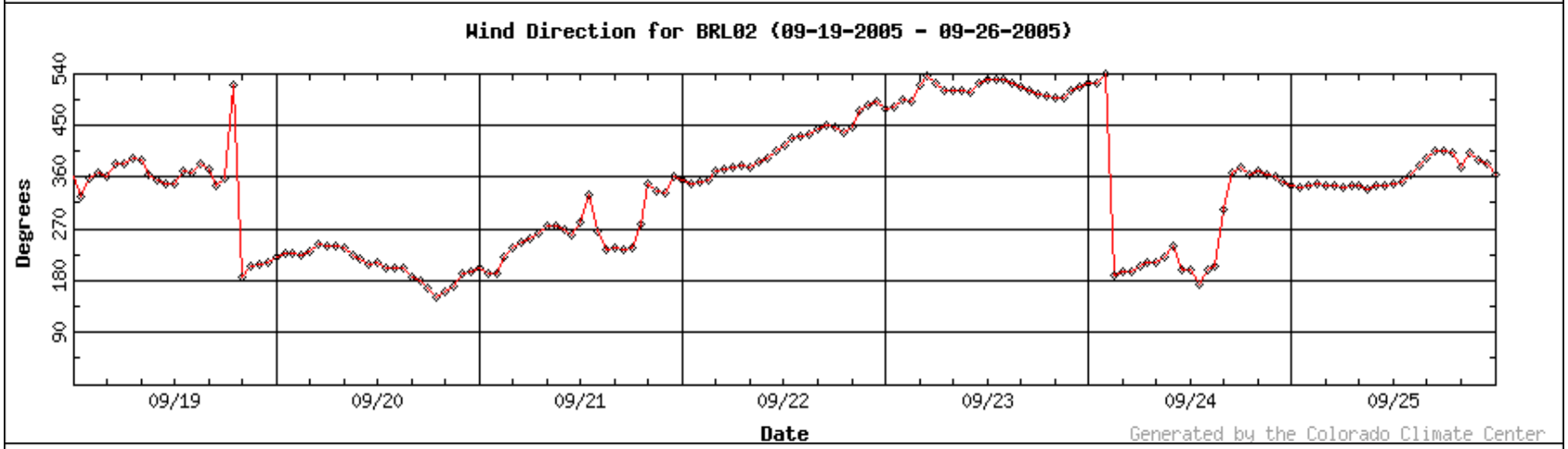


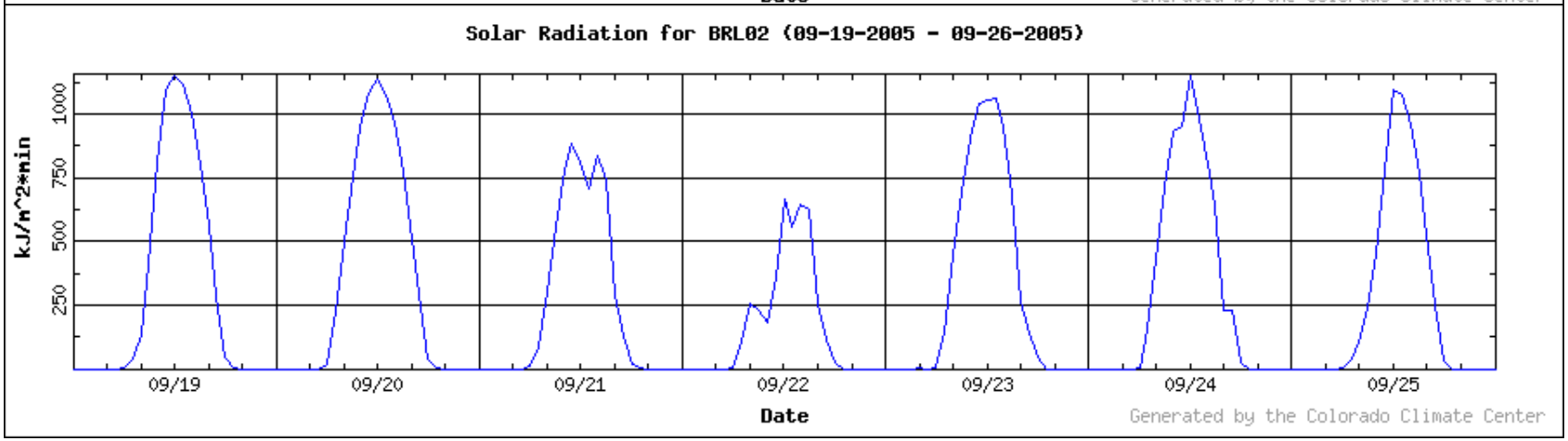
Sep 2006-2007



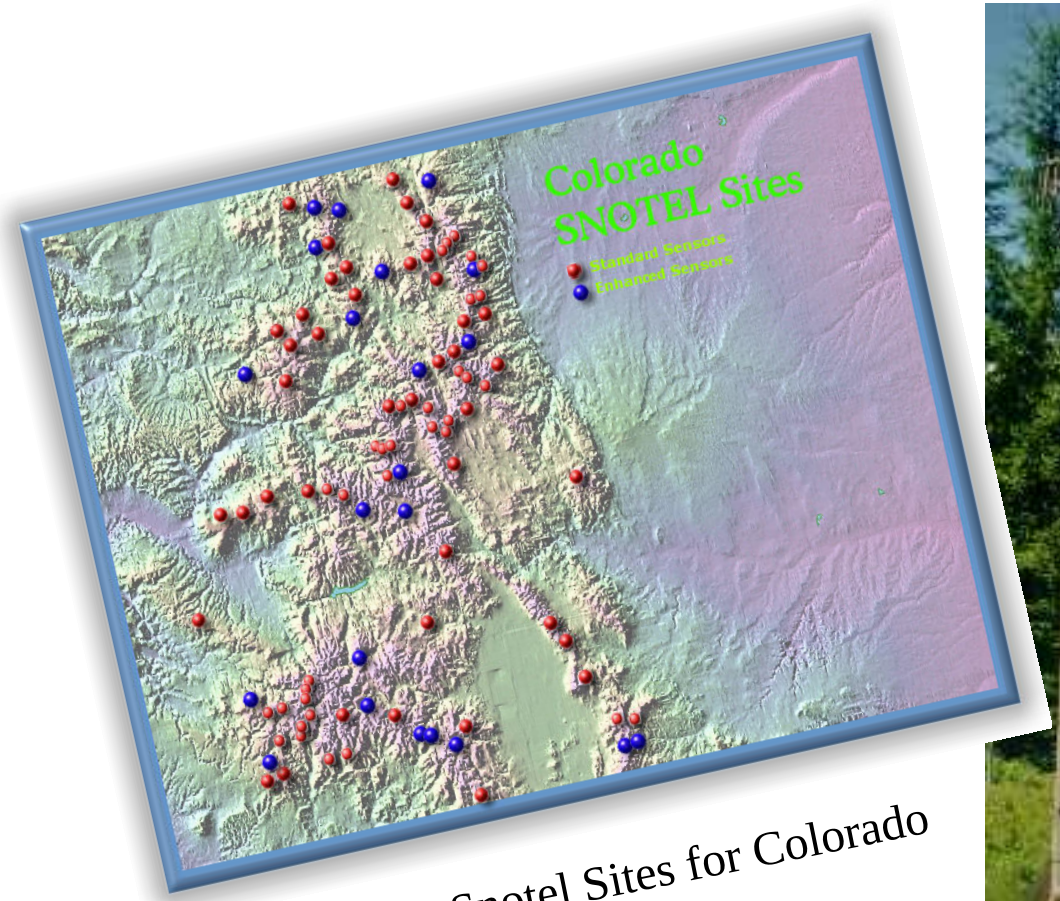
Burlington South



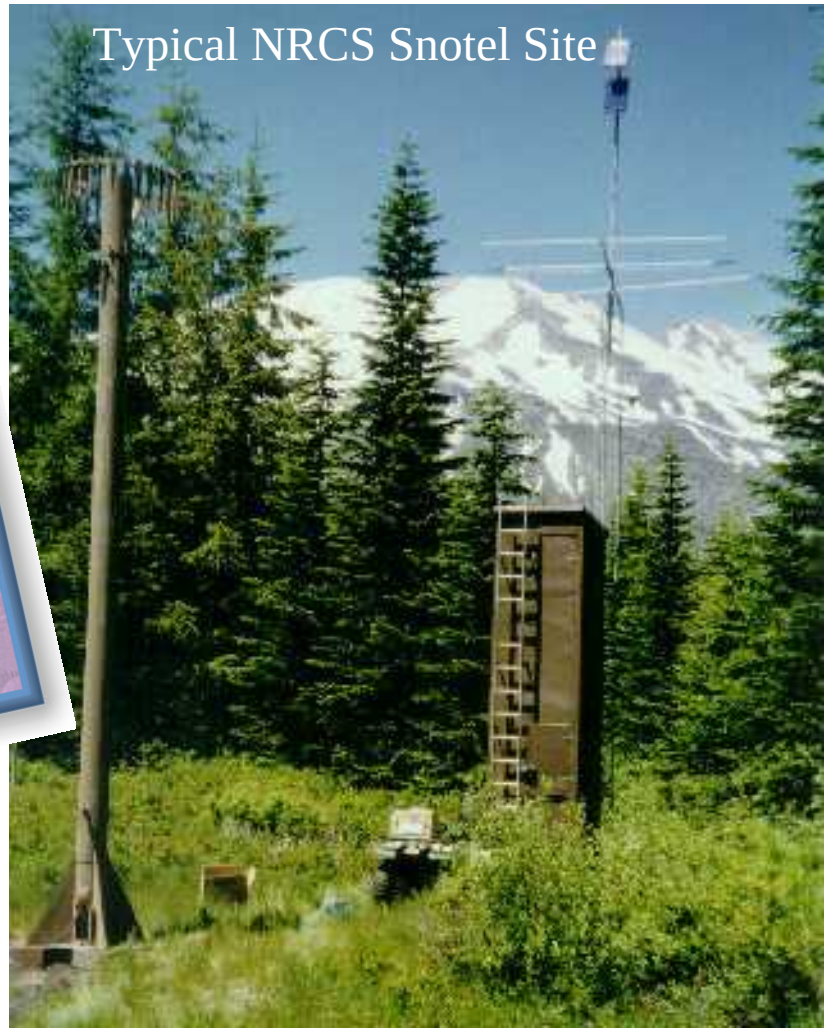




USDA, Natural Resources Conservation Service

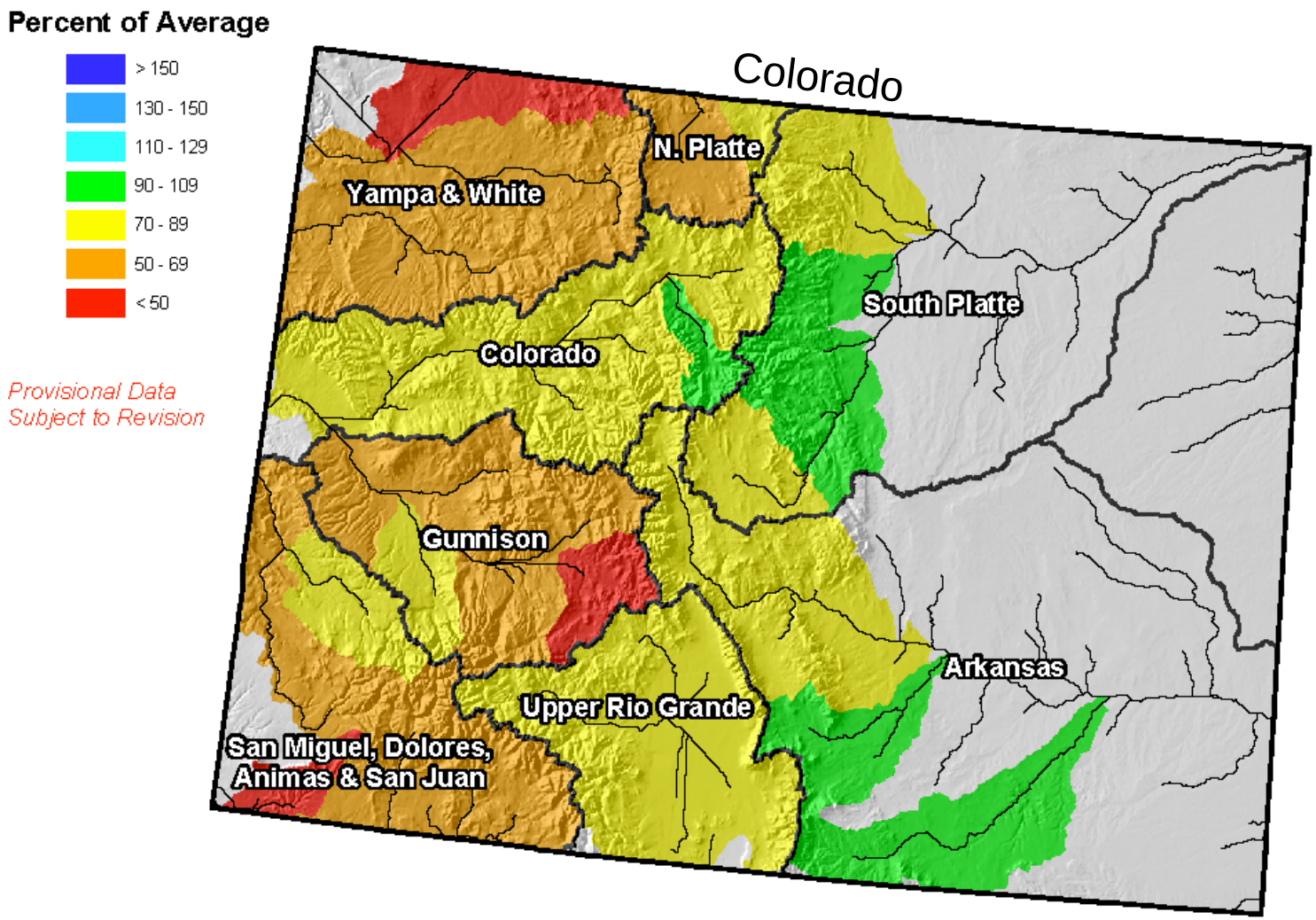


NRCS Snotel Sites for Colorado



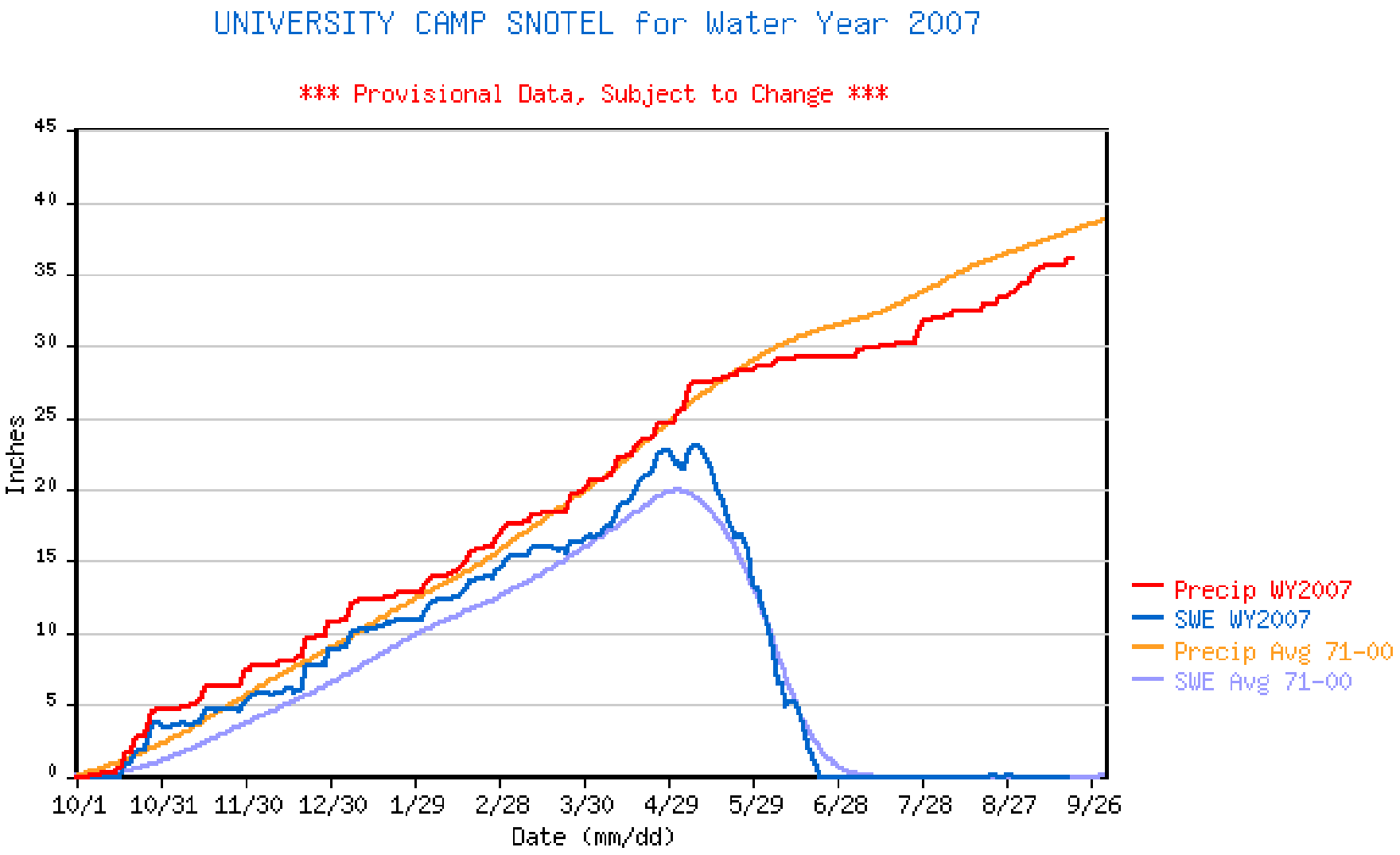
NRCS Colorado Streamflow Forecast

http://www.co.nrcs.usda.gov/



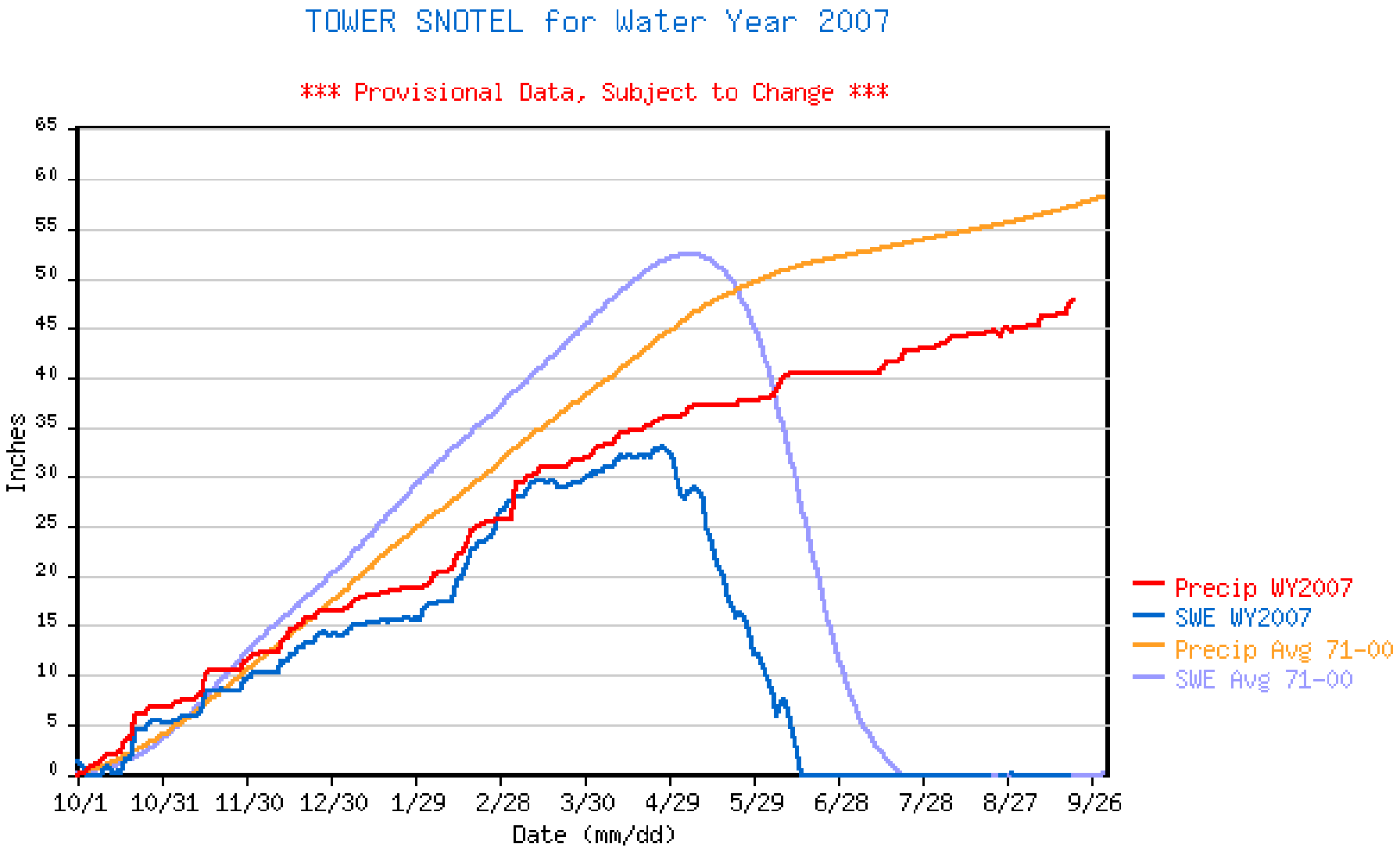
Current as of May 1, 2007

University Camp Snotel WY2007



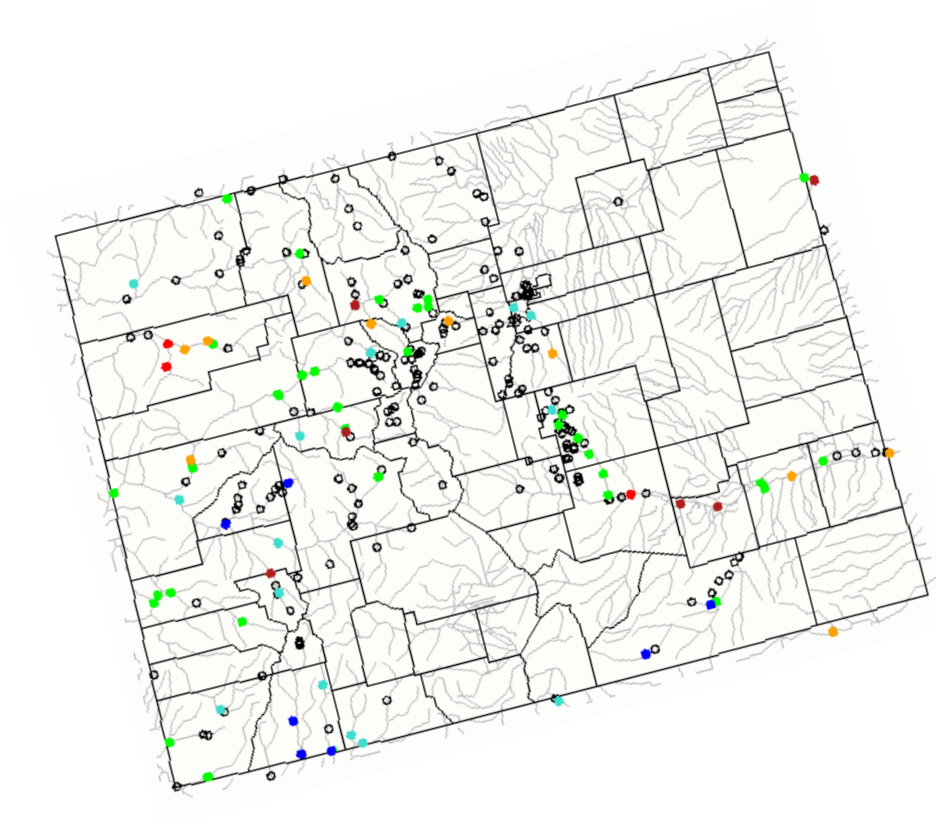
http://www.wcc.nrcs.usda.gov/snow/

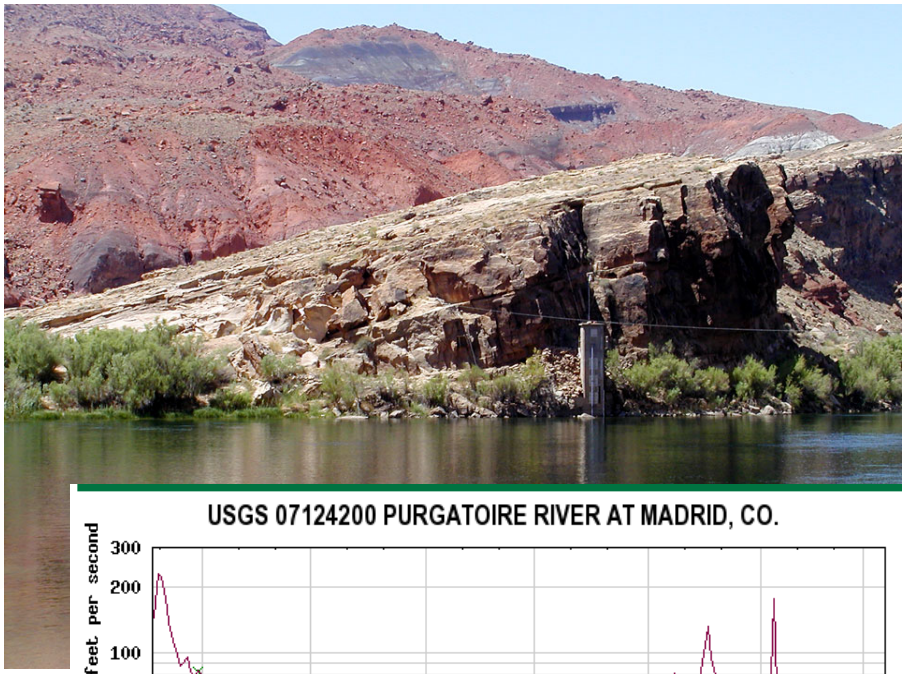
Tower Snotel WY2007

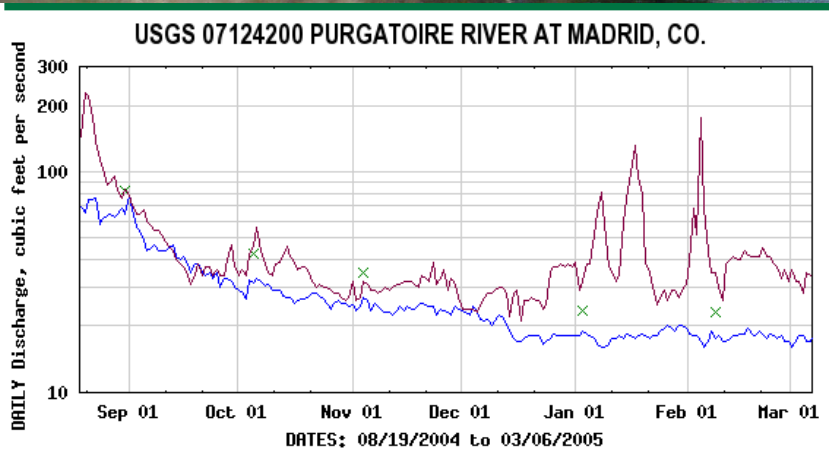


http://www.wcc.nrcs.usda.gov/snow/

U.S. Geological Survey



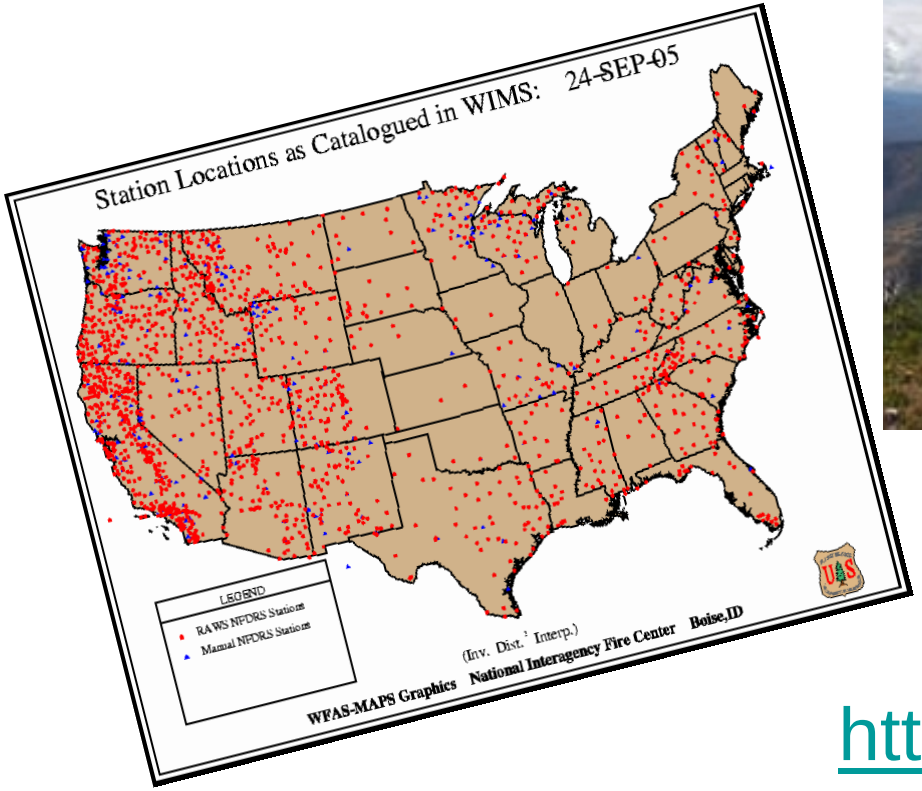




http://water.usgs.gov/waterwatch/

Other Data Sources

RAWS (Remote Automated Weather Stations)

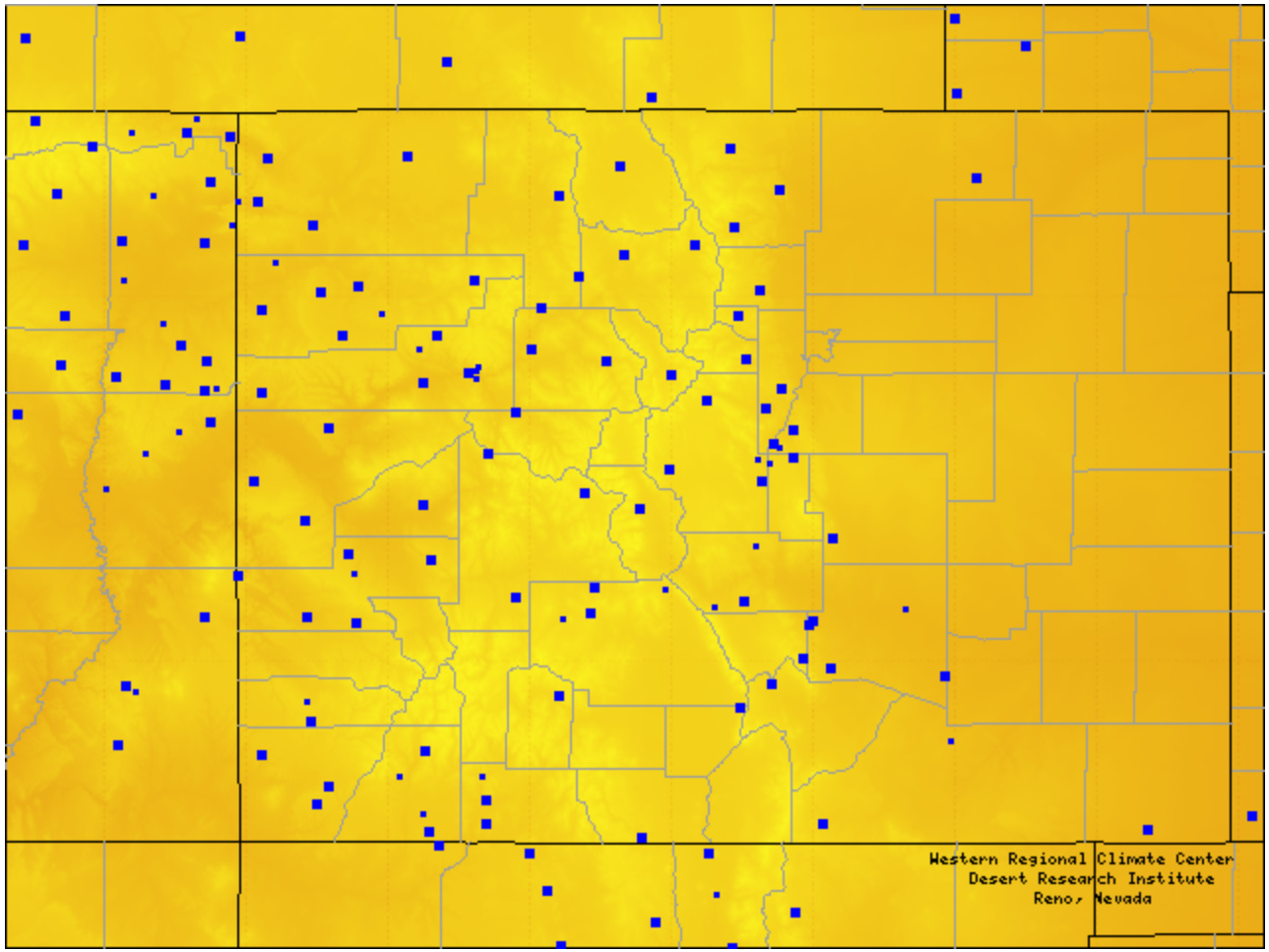


Storm King RAWS

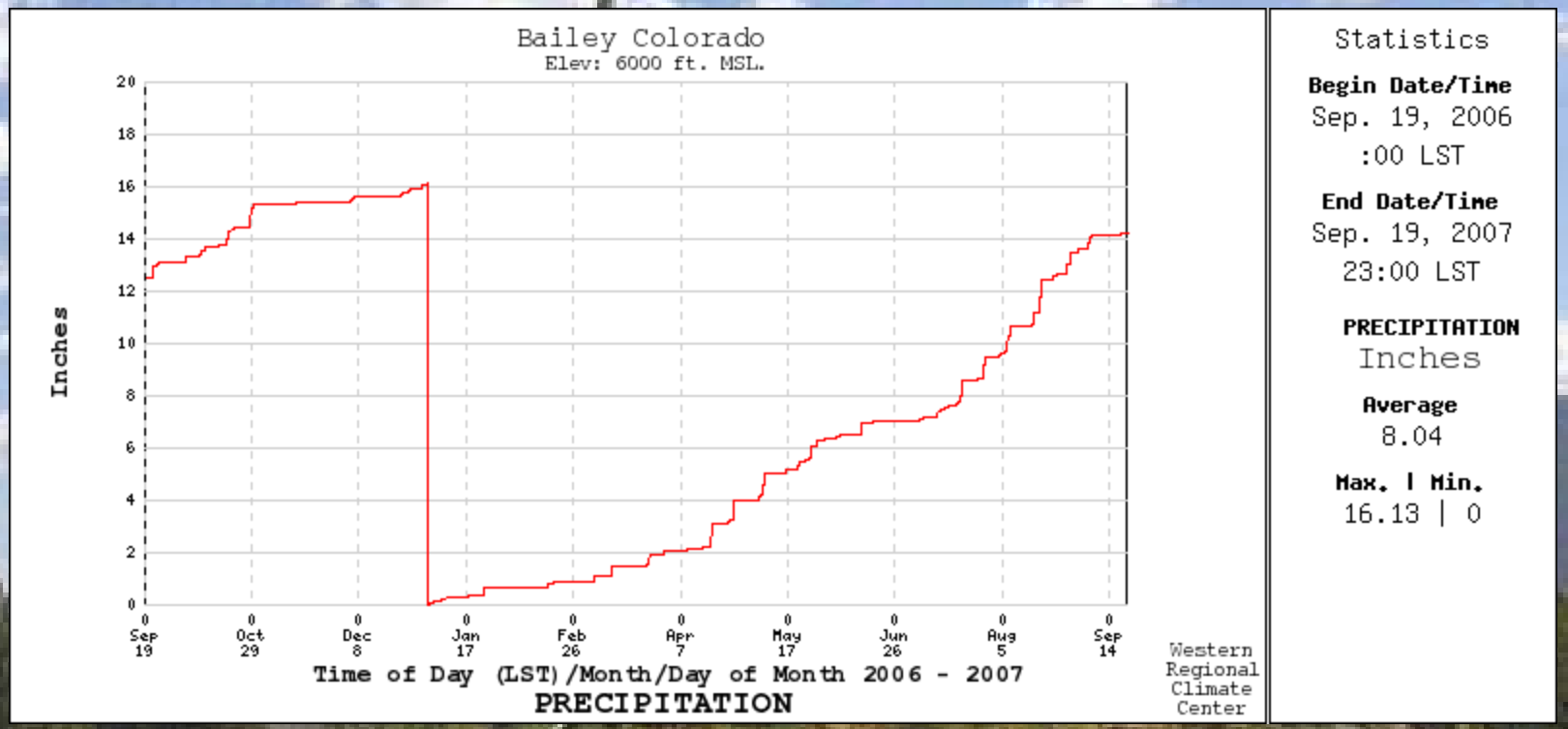
http://www.fs.fed.us/raws/

http://www.raws.dri.edu

COLORADO

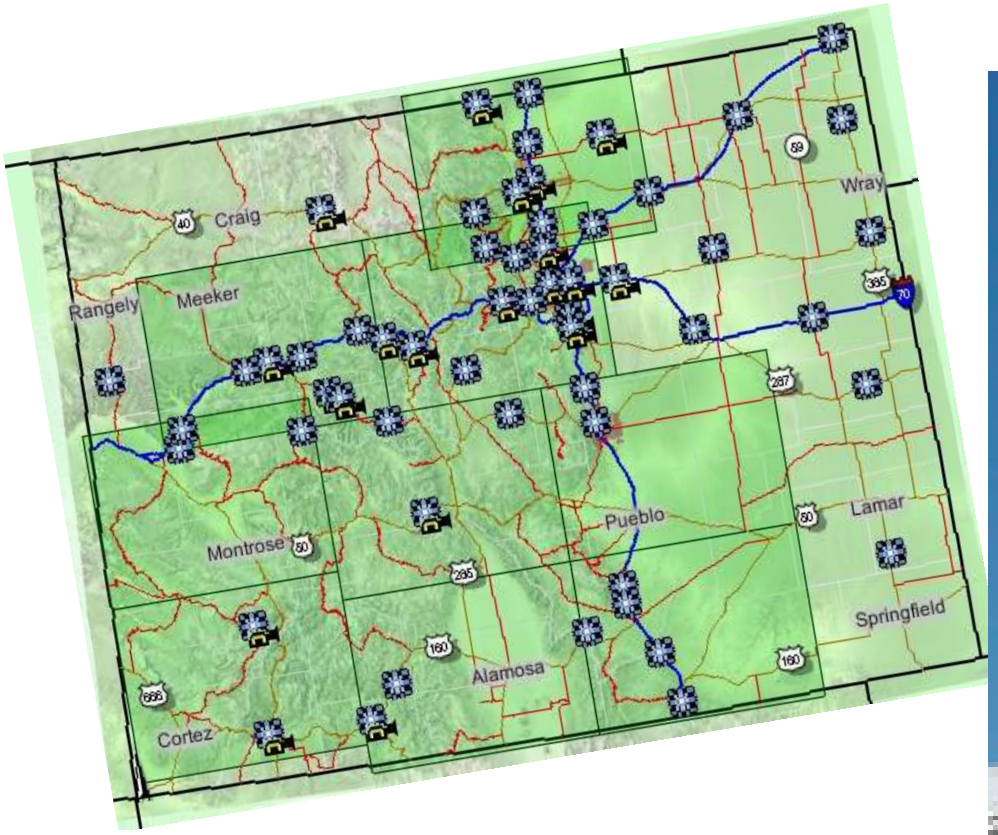


http://www.raws.dri.edu



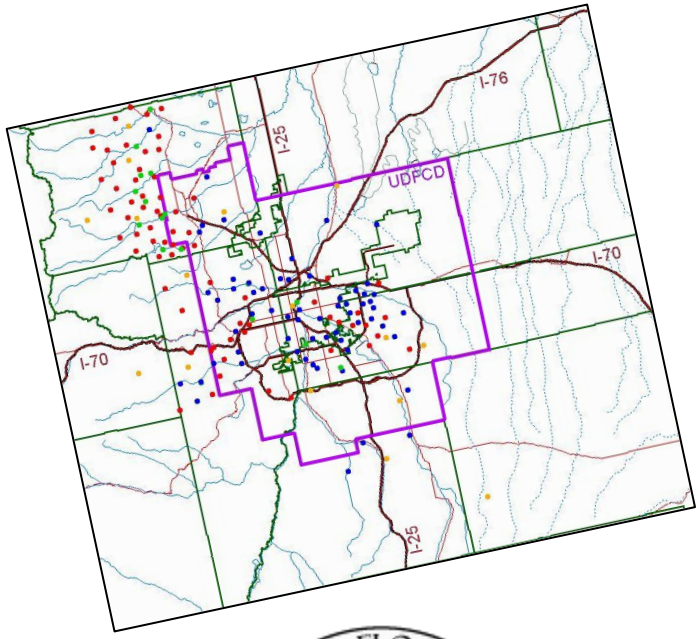
School Weather Stations

Colorado Department of Transportation (CDOT)



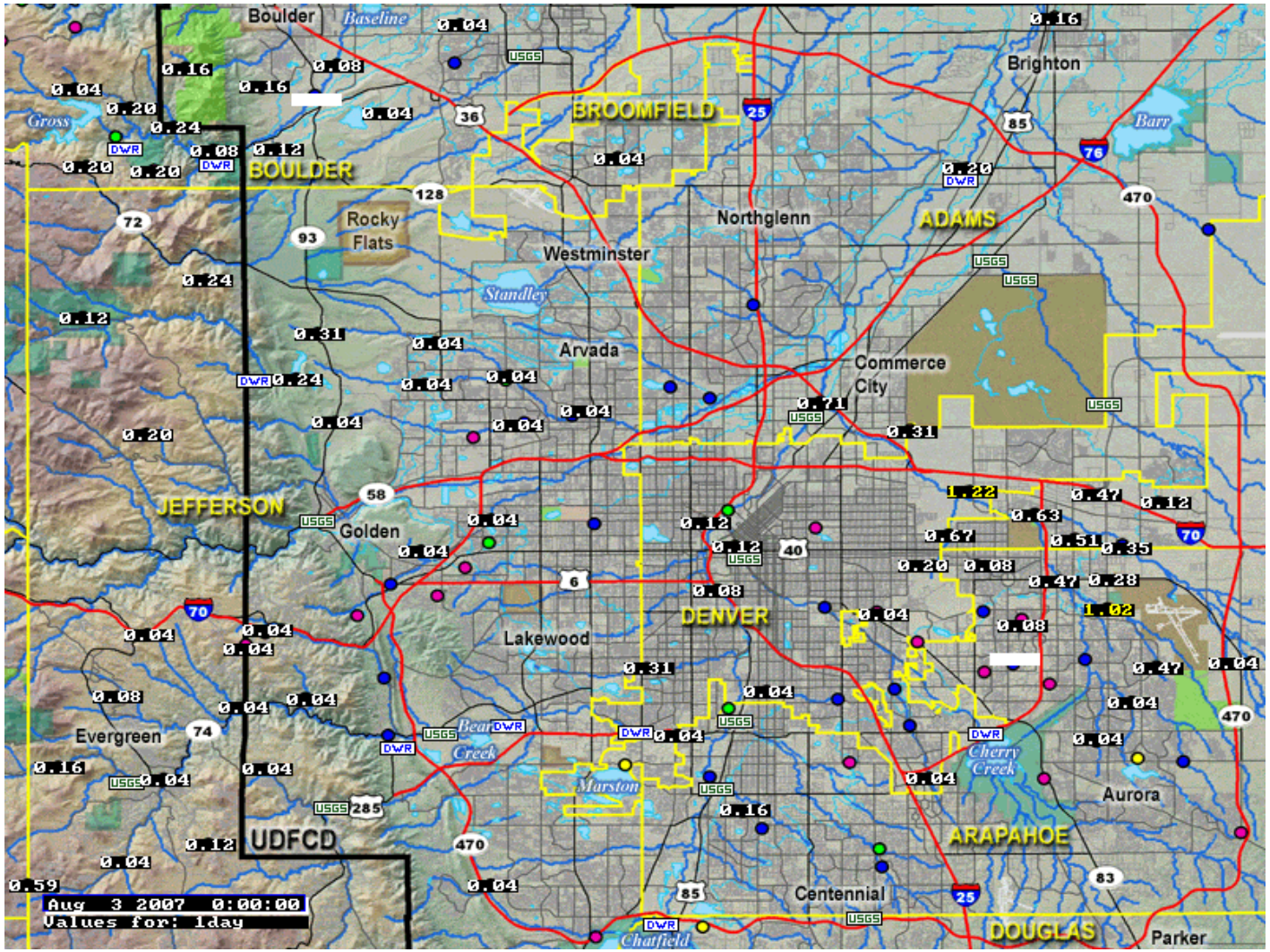
http://cotrip.org

Urban Drainage and Flood Control District (UDFCD) ALERT system

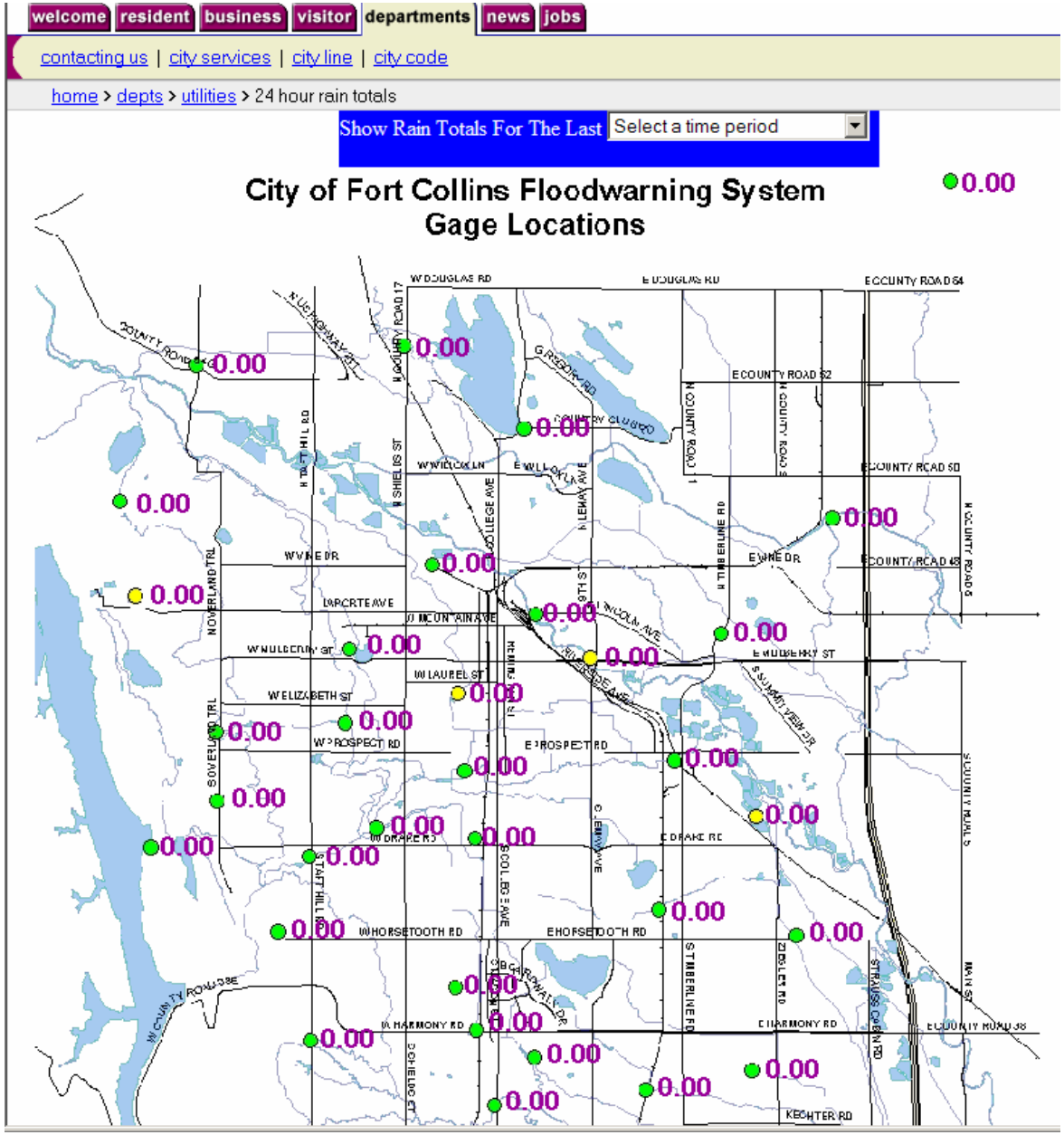


New ALERT weather station & stream gauge on Marston Lake North Drainageway.

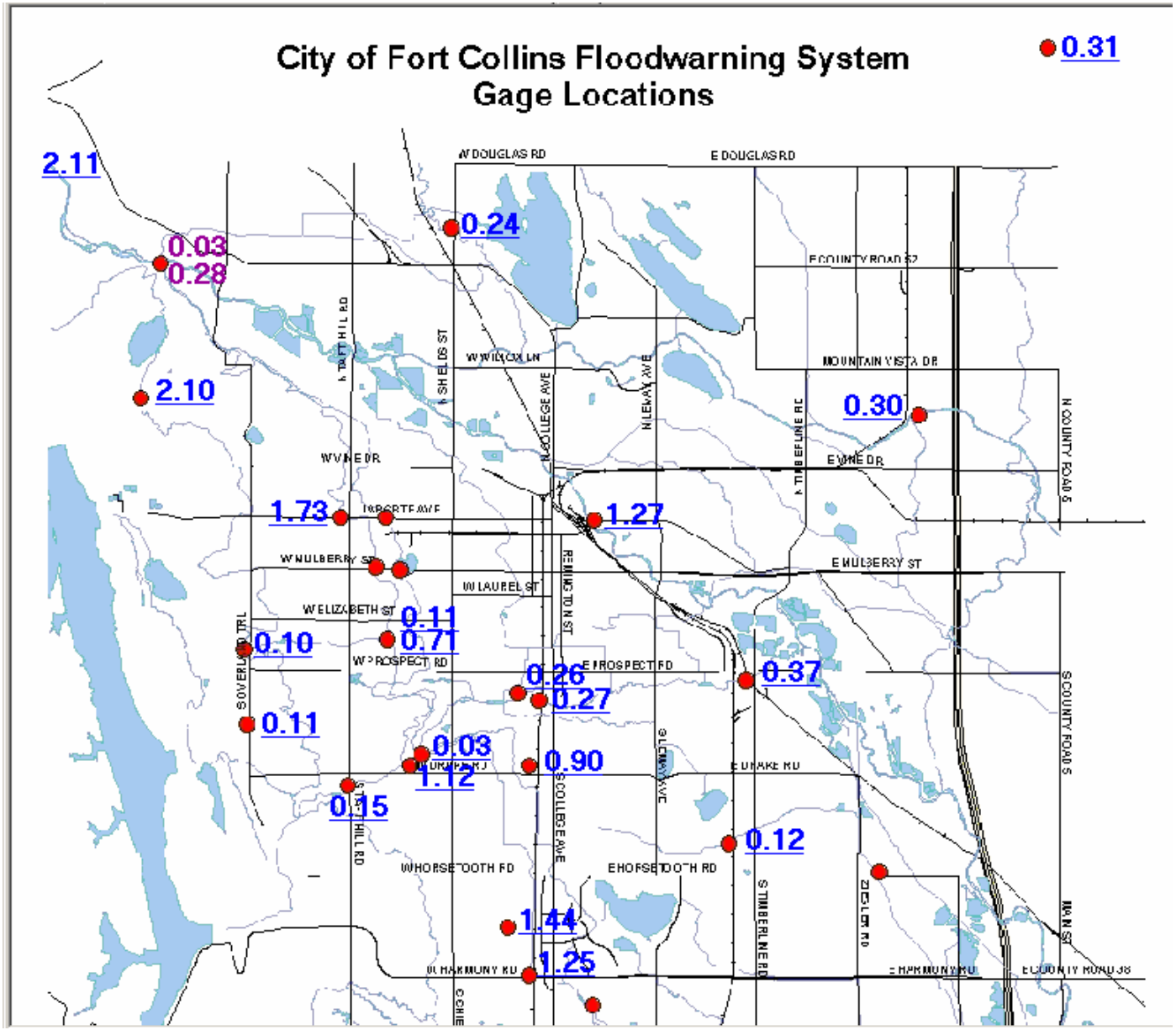
http://alert.udfcd.org



http://www.fcgov.com/stormwater/rain.php



http://www.fcgov.com/stormwater/flow.php

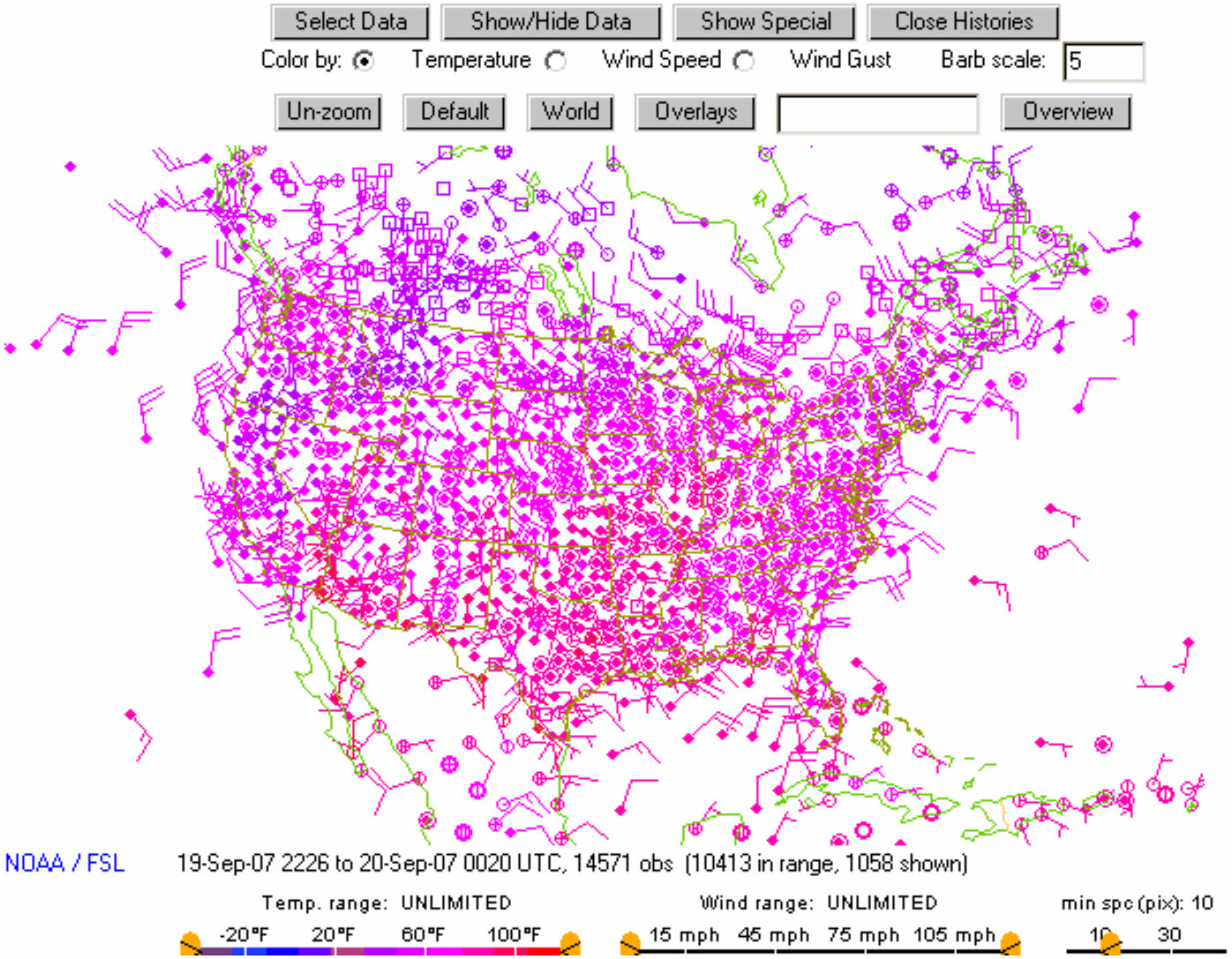


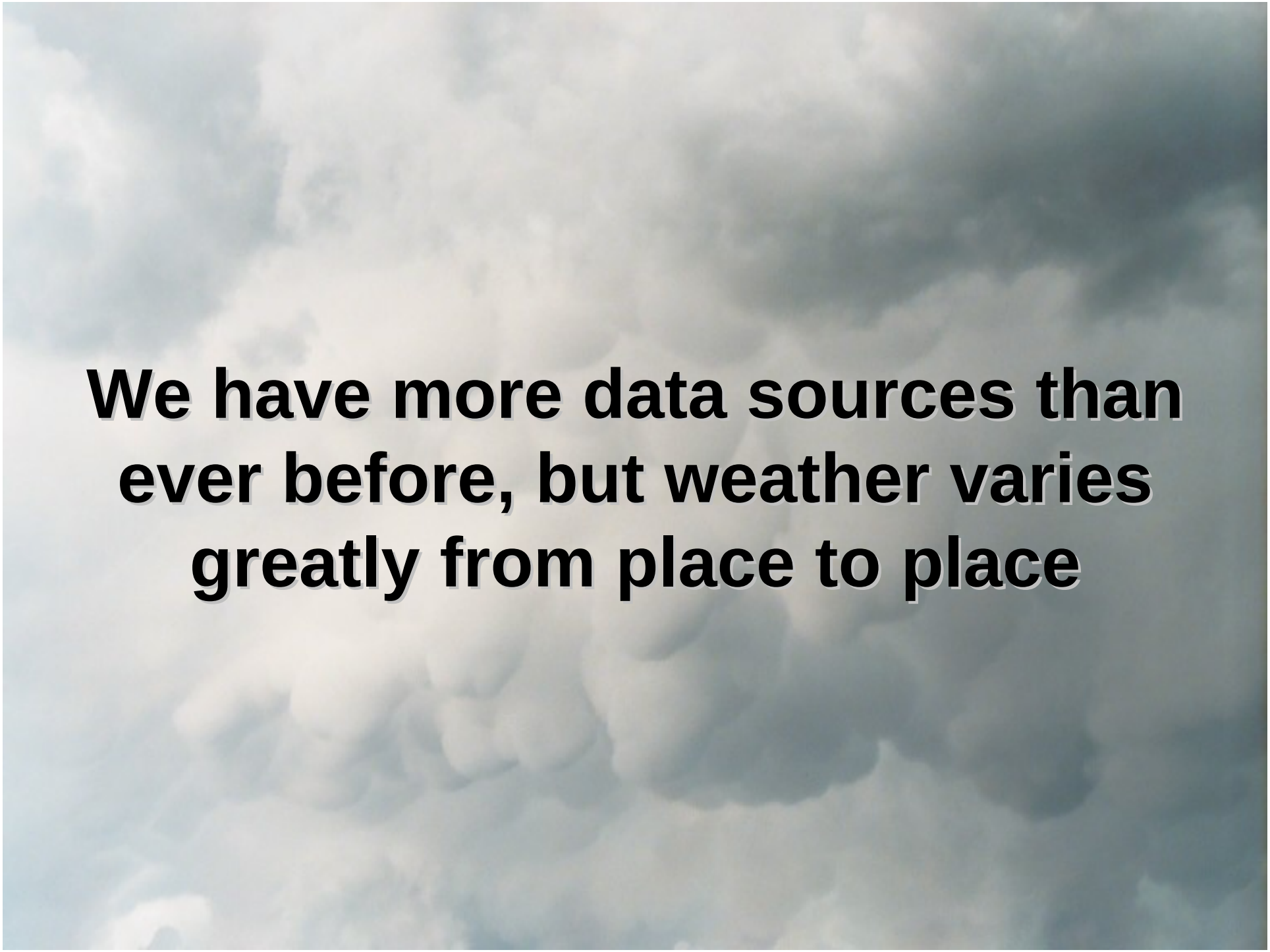
And if you can't get enough data try this one!

Meteorological Assimilation Data Ingest System (MADIS)

http://madis.noaa.gov/

MADIS Map for 9/19/07




We have more data sources than ever before, but weather varies greatly from place to place

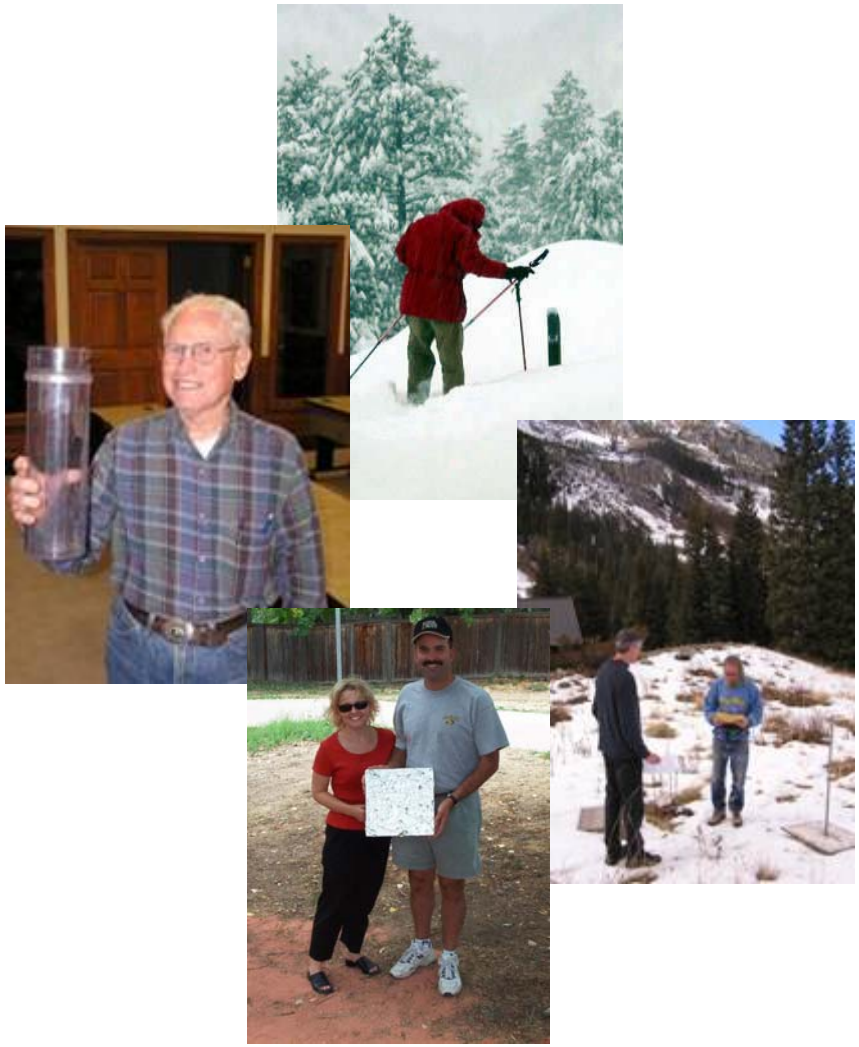
Community Collaborative Rain, Hail and Snow Network

The Origin of CoCoRaHS

The Fort Collins Flood of July 28, 1997

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).



CoCoRaHS: Simple tools to study rain and snow

Rain Gauge

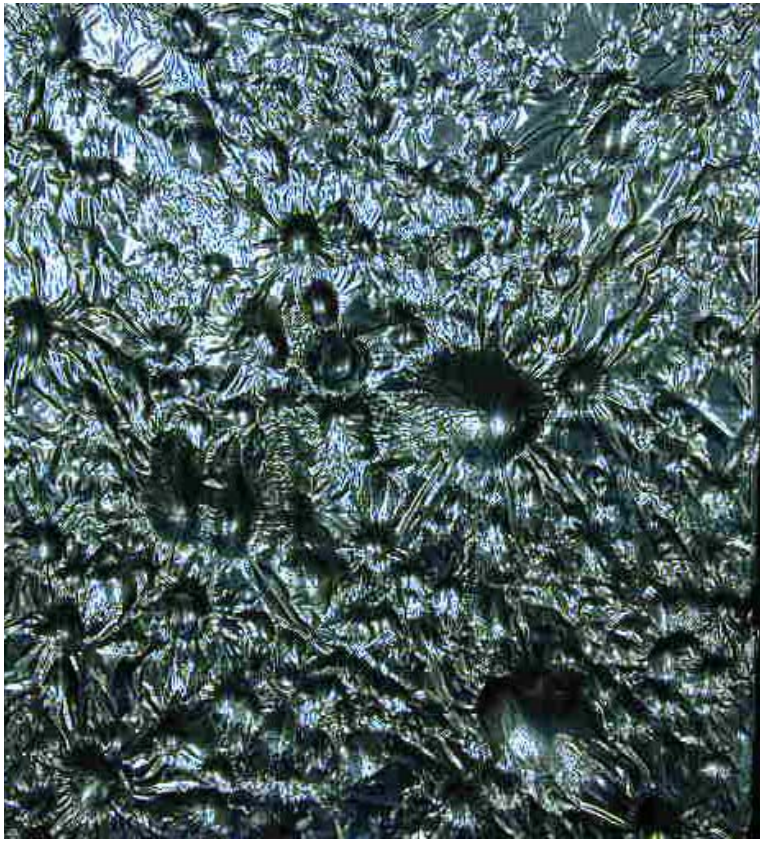
Example Station

CoCo RaHS Gauge in March 2003 Snowstorm

Arapahoe County CoCo RaHS observer near Cherry Creek, Colorado

CoCoRaHS: Simple Tools to Study Hail

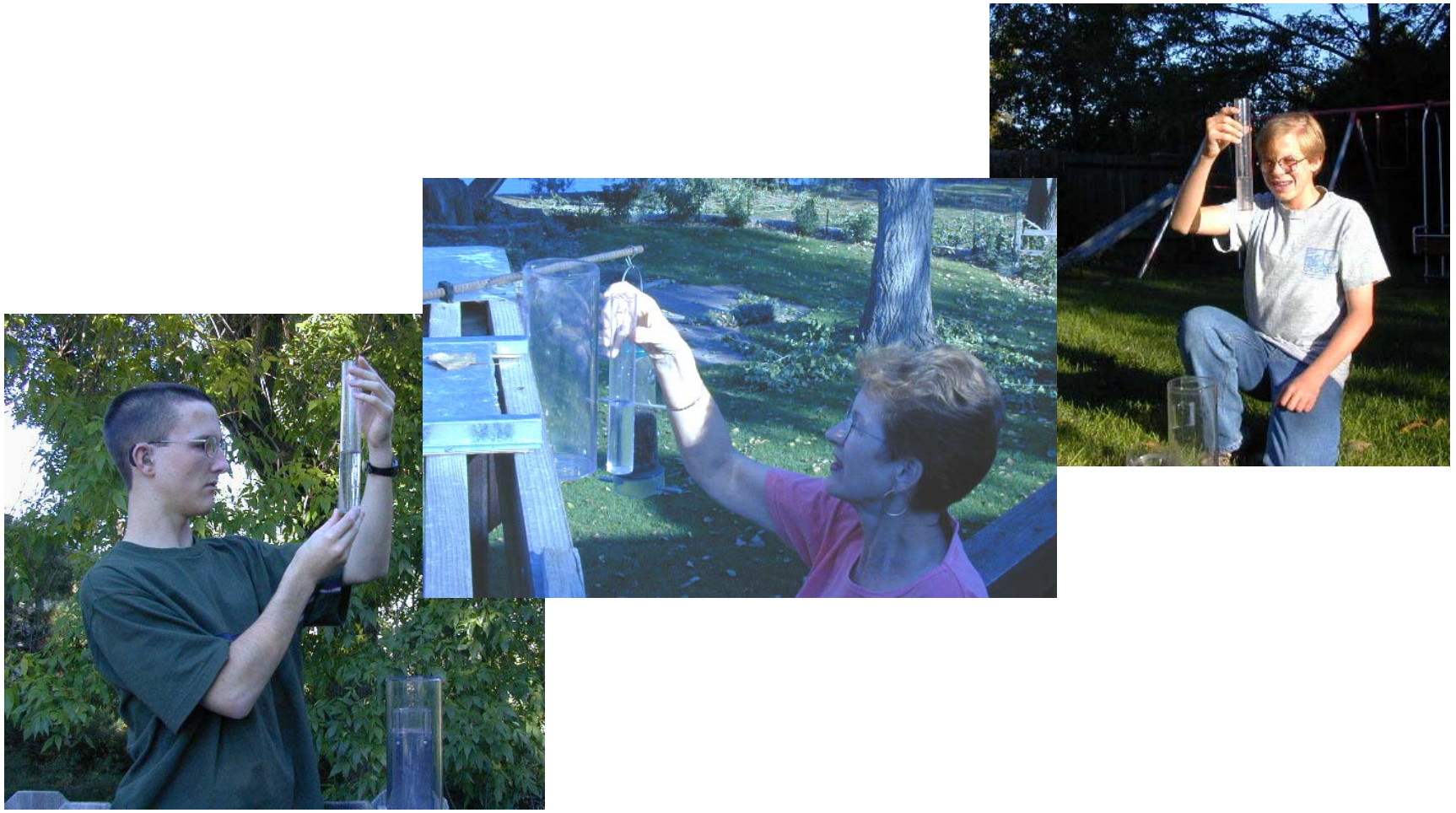
Hail Pad

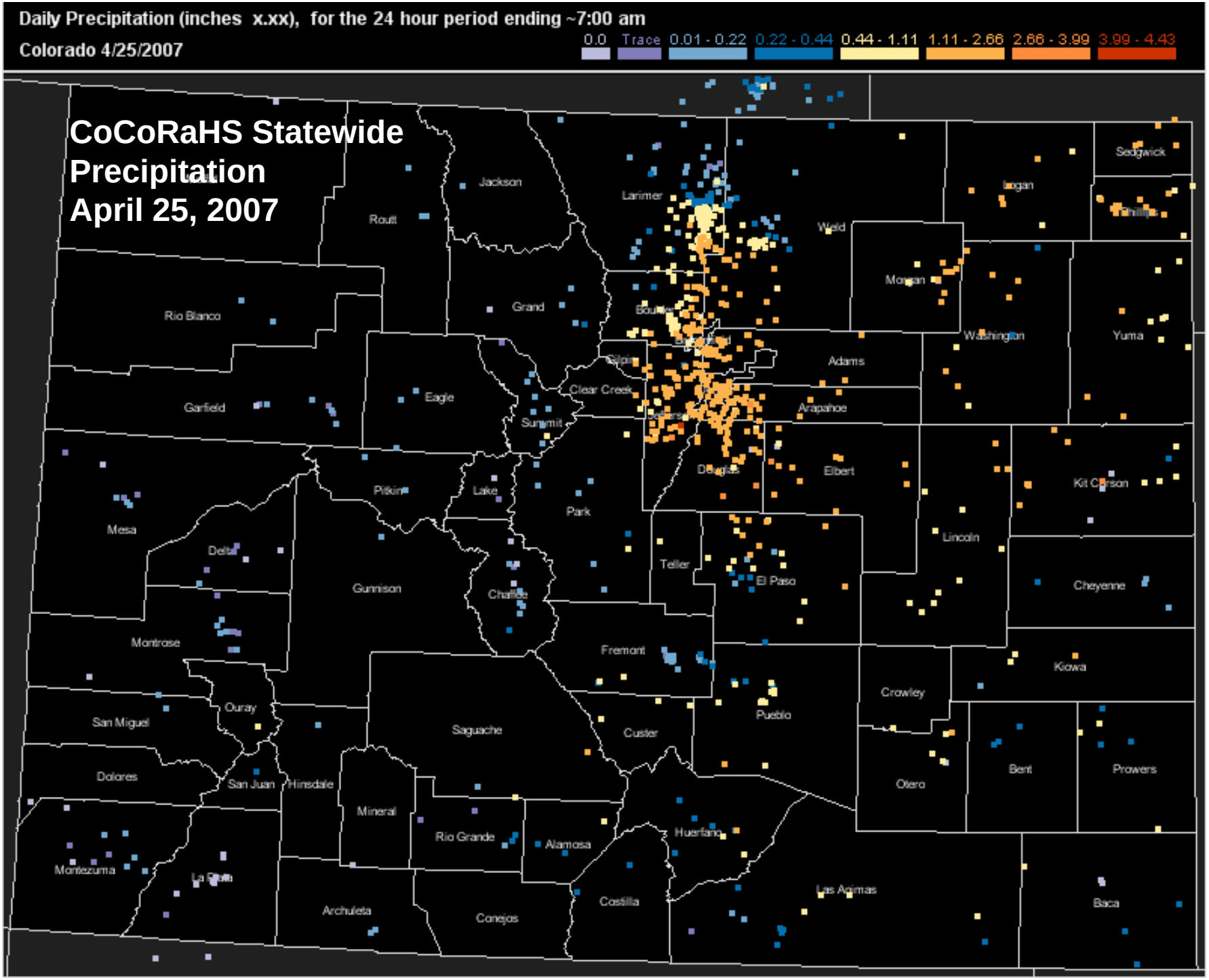


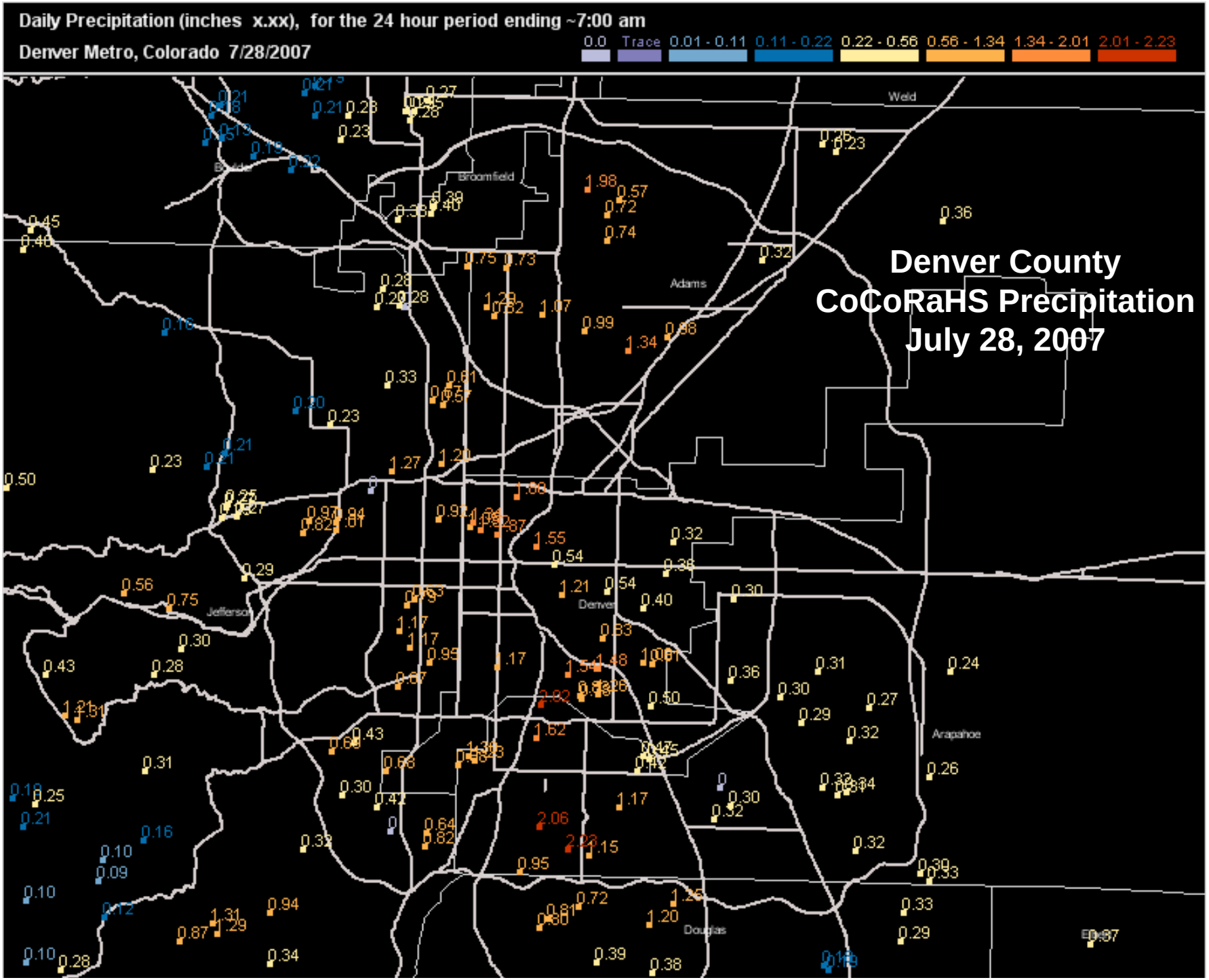
Damaged Hail Pad

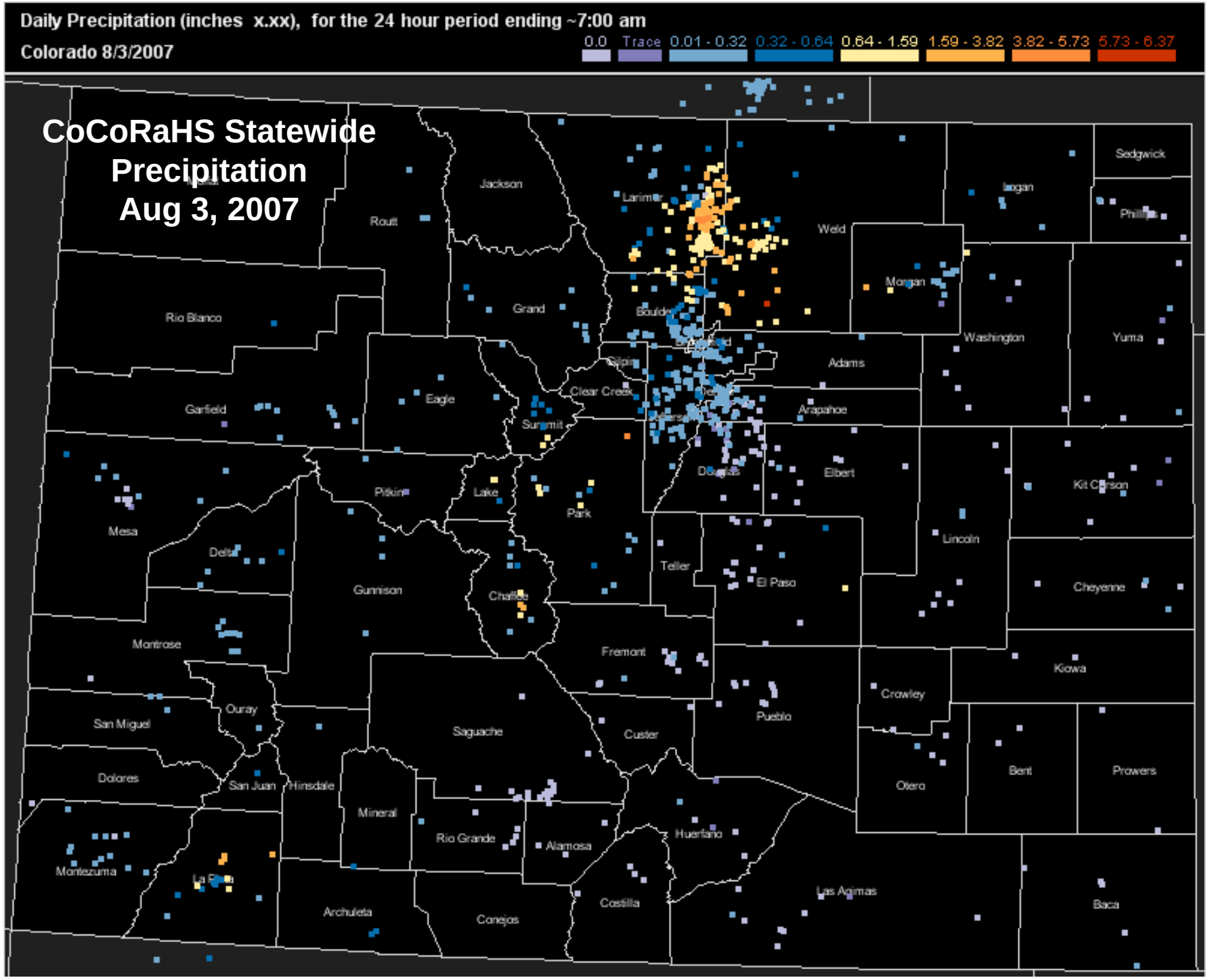
Example Hail Pad Stands

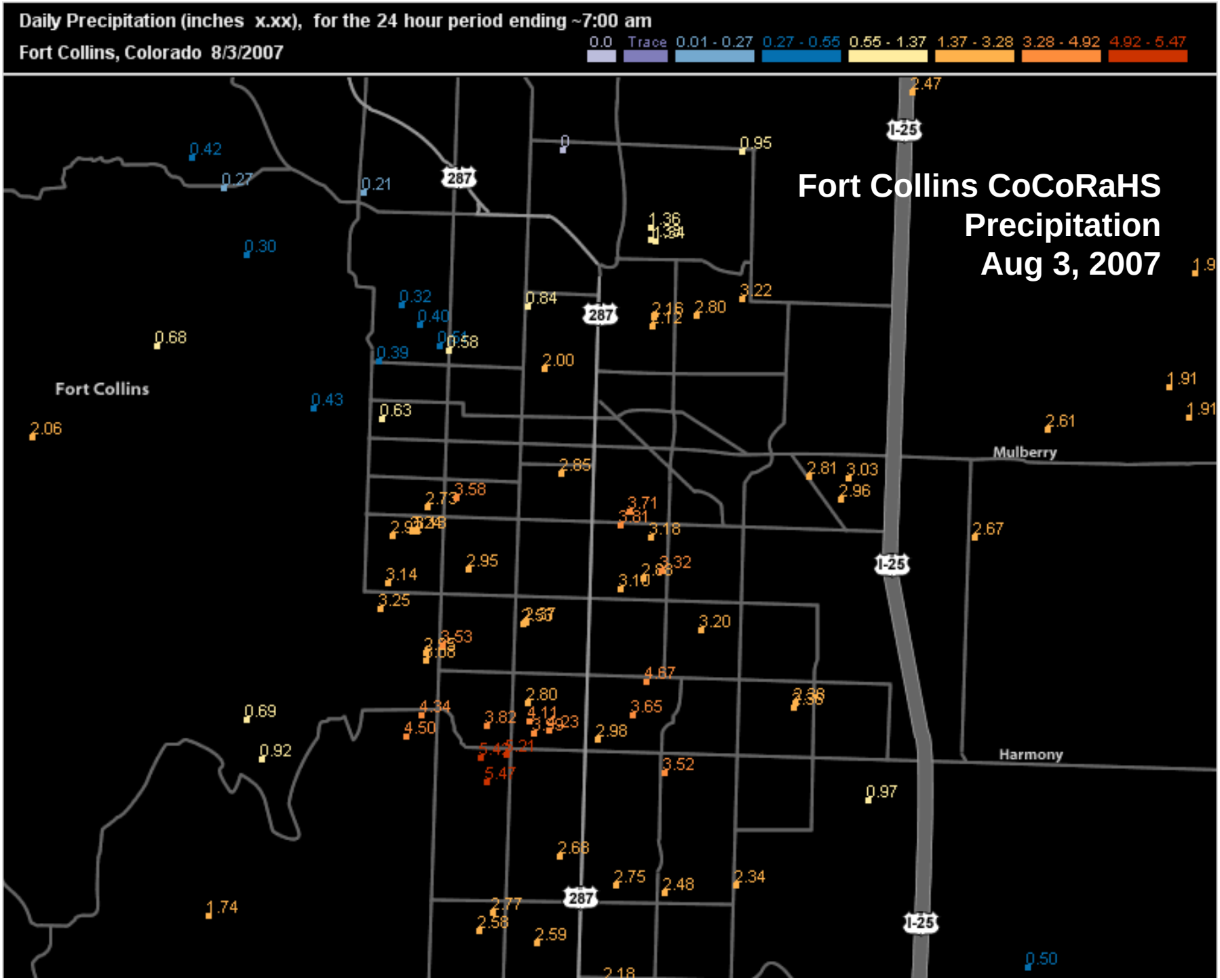
CoCoRaHS – Supplementing NWS Cooperative Program to Improve Precipitation Measurements




Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Colorado 4/25/2007
0.0 Trace 0.01 - 0.22 0.22 - 0.44 0.44 - 1.11 1.11 - 2.66 2.66 - 3.99 3.99 - 4.43
CoCoRaHS Statewide Precipitation April 25, 2007
Jackson
Routt
Larimer
Weld
Logan
Sedgwick
Rio Blanco
Grand
Morgan
Washington
Yuma
Garfield
Eagle
Clear Creek
Summit
Adams
Arapahoe
Elbert
Kit Carson
Pitkin
Lake
Park
Douglas
Lincoln
Mesa
Delta
Gunmison
Chaffee
Teller
El Paso
Cheyenne
Montrose
Fremont
Kiowa
Ouray
San Miguel
Saguache
Custer
Pueblo
Crowley
Dolores
San Juan
Hinsdale
Mineral
Rio Grande
Alamosa
Huerfano
Otero
Bent
Prowers
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca


Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Denver Metro, Colorado 7/28/2007
0.0 Trace 0.01 - 0.11 0.11 - 0.22 0.22 - 0.56 0.56 - 1.34 1.34 - 2.01 2.01 - 2.23
Weld
Broomfield
Adams
Denver
Jefferson
Arapahoe
Douglas
Denver County
CoCoRaHS Precipitation
July 28, 2007


Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Colorado 8/3/2007
0.0 Trace 0.01 - 0.32 0.32 - 0.64 0.64 - 1.59 1.59 - 3.82 3.82 - 5.73 5.73 - 6.37
CoCoRaHS Statewide Precipitation Aug 3, 2007
Jackson
Routt
Larimer
Weld
Logan
Sedgwick
Phillips
Morgan
Grand
Rio Blanco
Boulder
Washington
Yuma
Adams
Clear Creek
Eagle
Garfield
Summit
Arapahoe
Douglas
Elbert
Kit Carson
Pitkin
Lake
Park
Mesa
Delta
Teller
El Paso
Lincoln
Cheyenne
Gunnison
Chaffee
Montrose
Fremont
Kiowa
Crowley
Ouray
San Miguel
Saguache
Custer
Pueblo
Dolores
San Juan
Hinsdale
Mineral
Rio Grande
Alamosa
Huerfano
Otero
Bent
Prowers
Montezuma
La Plata
Archuleta
Conejos
Costilla
Las Animas
Baca


Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Fort Collins, Colorado 8/3/2007
0.0 Trace 0.01 - 0.27 0.27 - 0.55 0.55 - 1.37 1.37 - 3.28 3.28 - 4.92 4.92 - 5.47
Fort Collins CoCoRaHS
Precipitation
Aug 3, 2007
Fort Collins
Mulberry
Harmony
I-25
287

We still need more Volunteers!!

Photos by H. Reges

A Review of the 2007 Water Year in Colorado

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

http://ccc.atmos.colostate.edu

Presented to 62st Annual Meeting of the Rocky Mountain Hydrologic Research Center (RMHRC), held at Allenspark, CO, September 28, 2007

Prepared by Odie Bliss

Highlights of the 2007 Water Year in Colorado

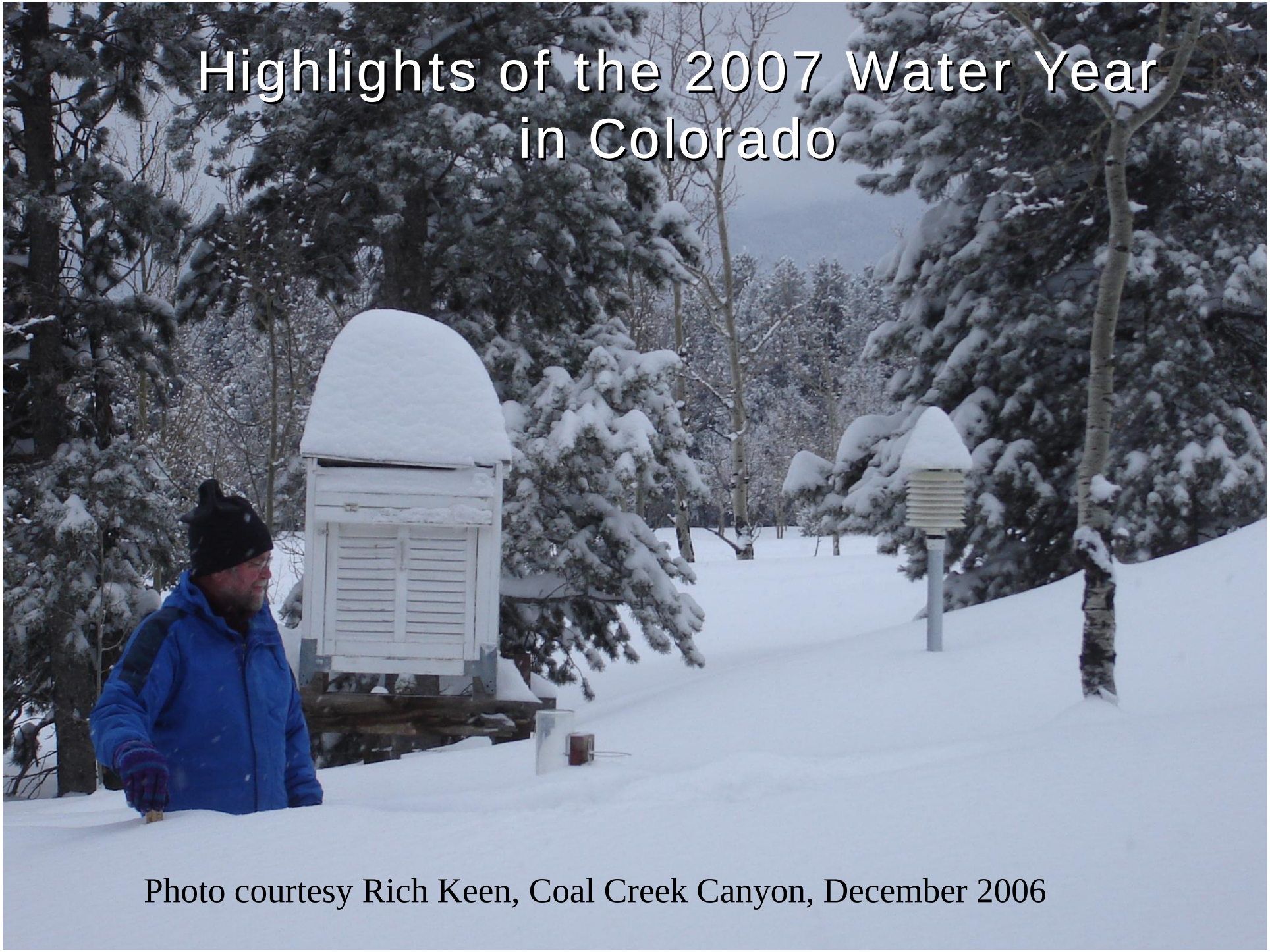
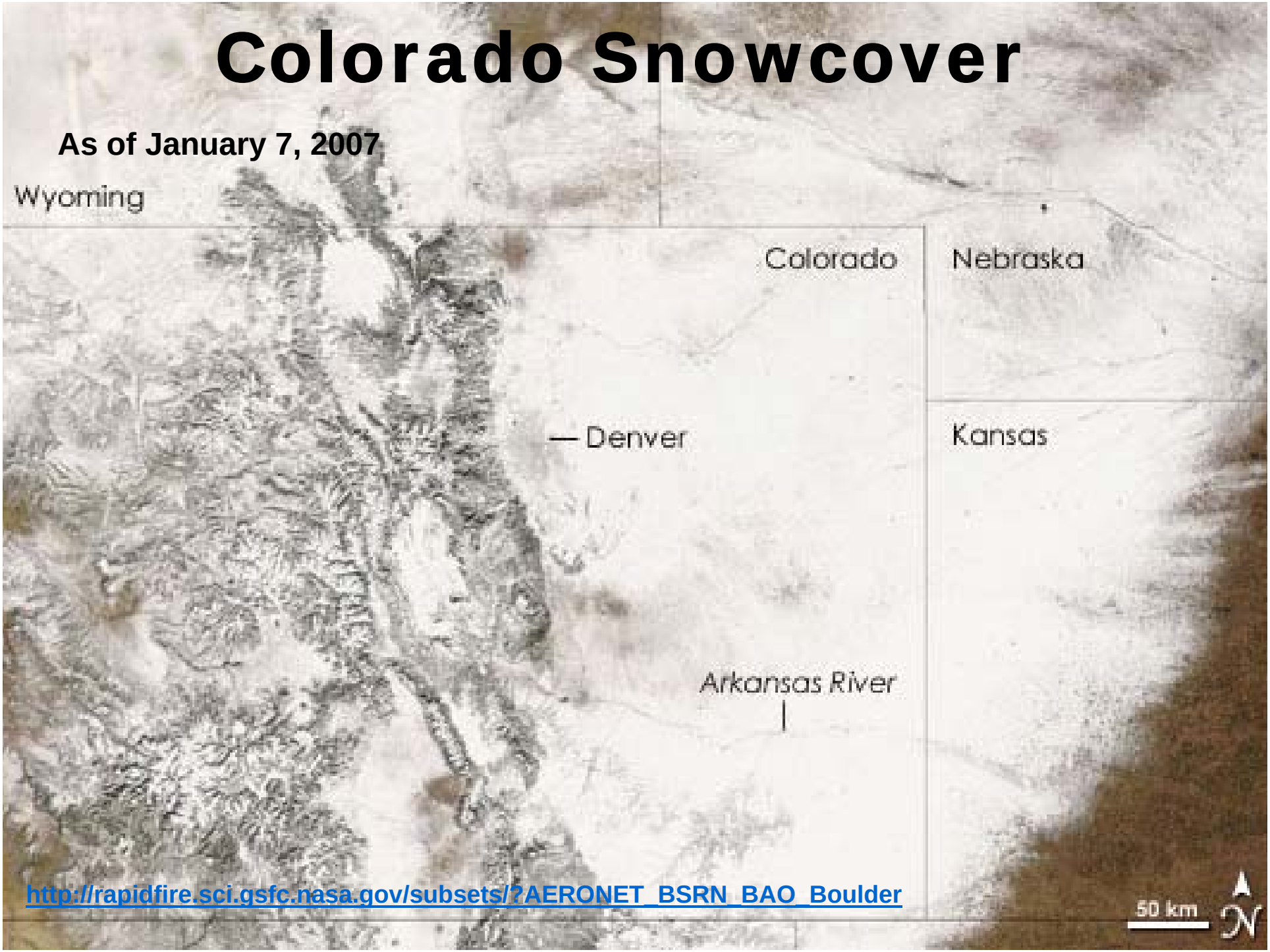


Photo courtesy Rich Keen, Coal Creek Canyon, December 2006

Colorado Snowcover

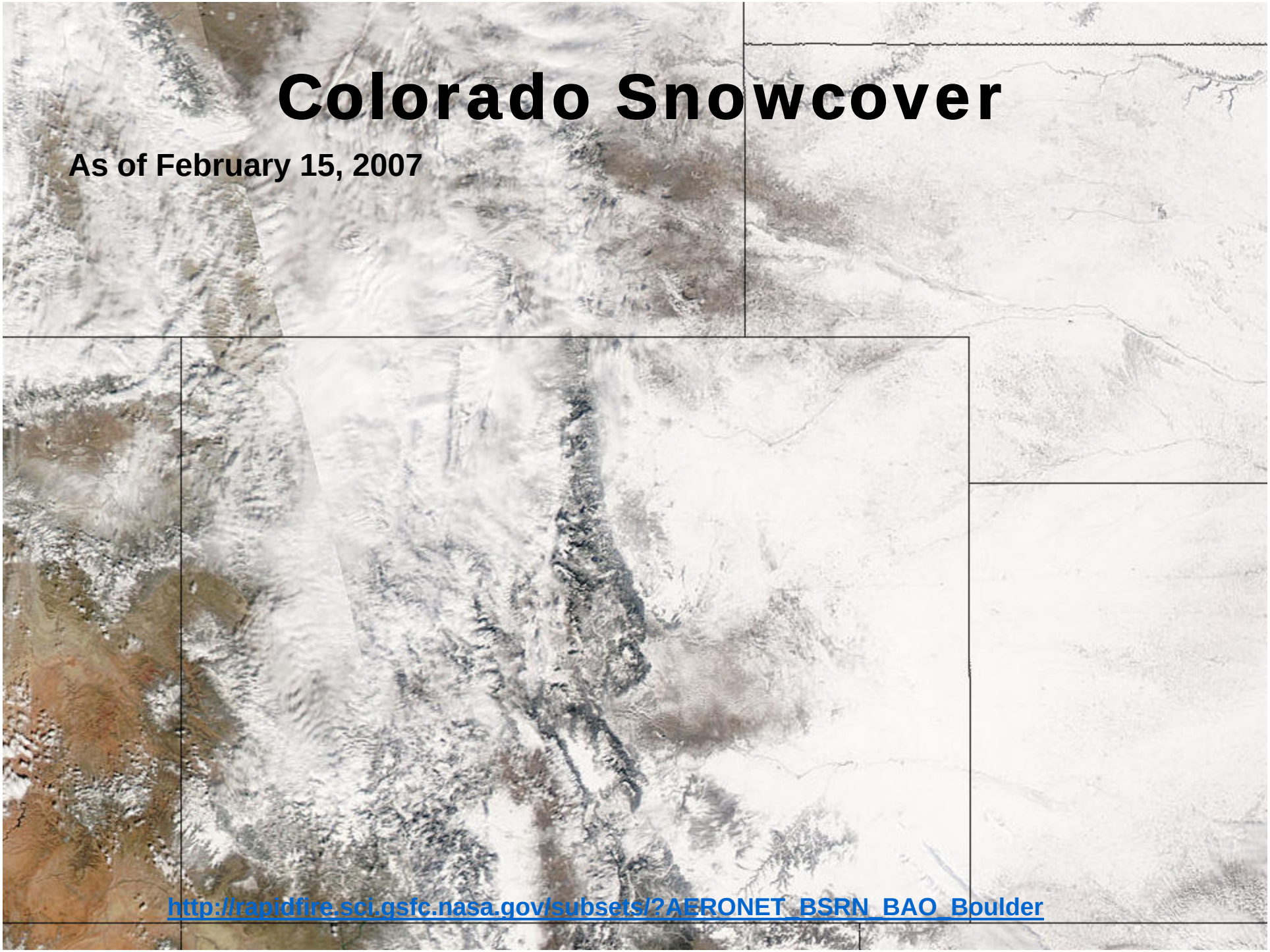
As of January 7, 2007



http://rapidfire.sci.gsfc.nasa.gov/subsets/?AERONET_BSRN_BAO_Boulder

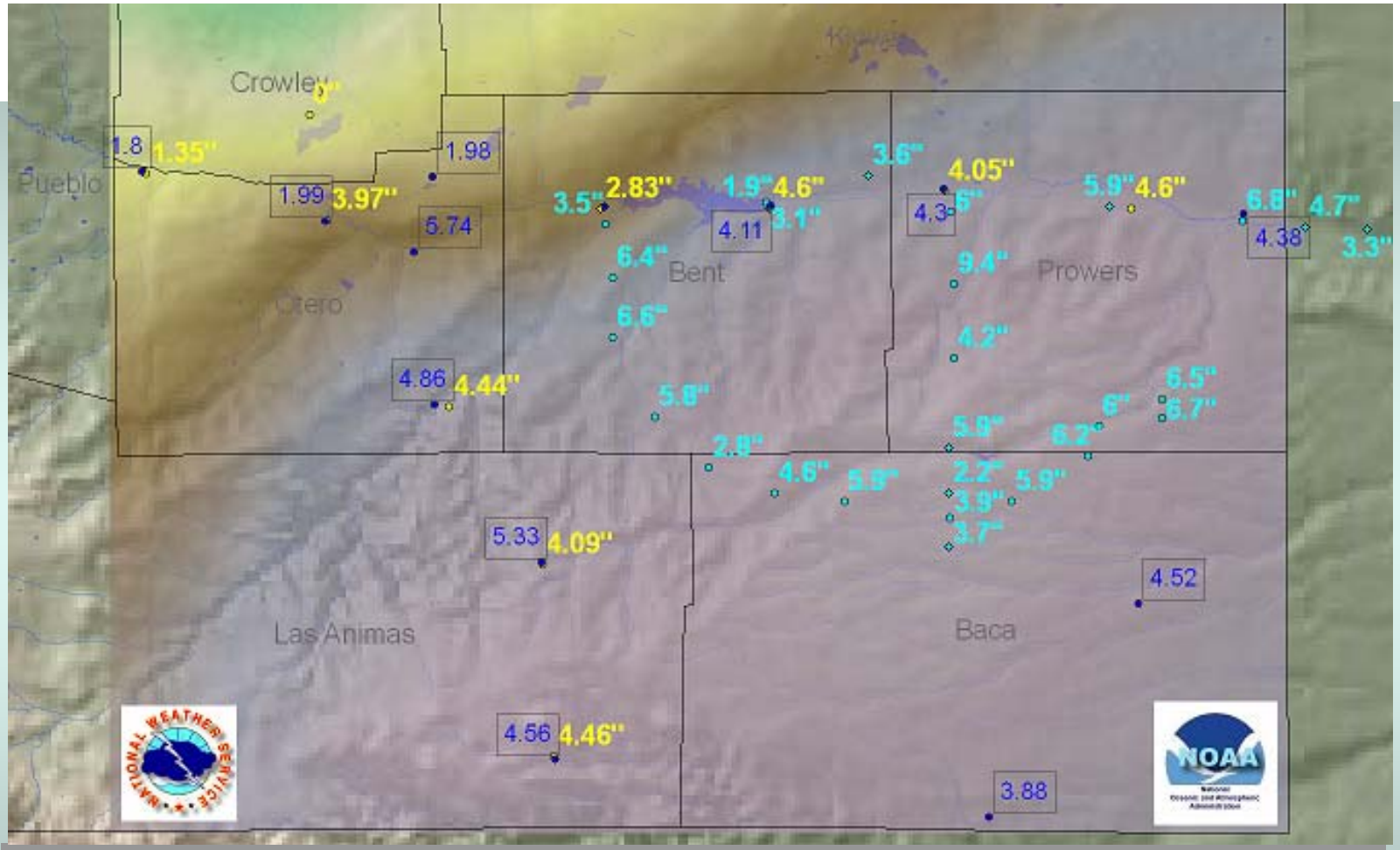
Colorado Snowcover

As of February 15, 2007



http://rapidfire.sci.gsfc.nasa.gov/subsets/?AERONET_BSRN_BAO_Boulder

Water in the Snowpack during early February and the Total Precipitation for the months of December and January

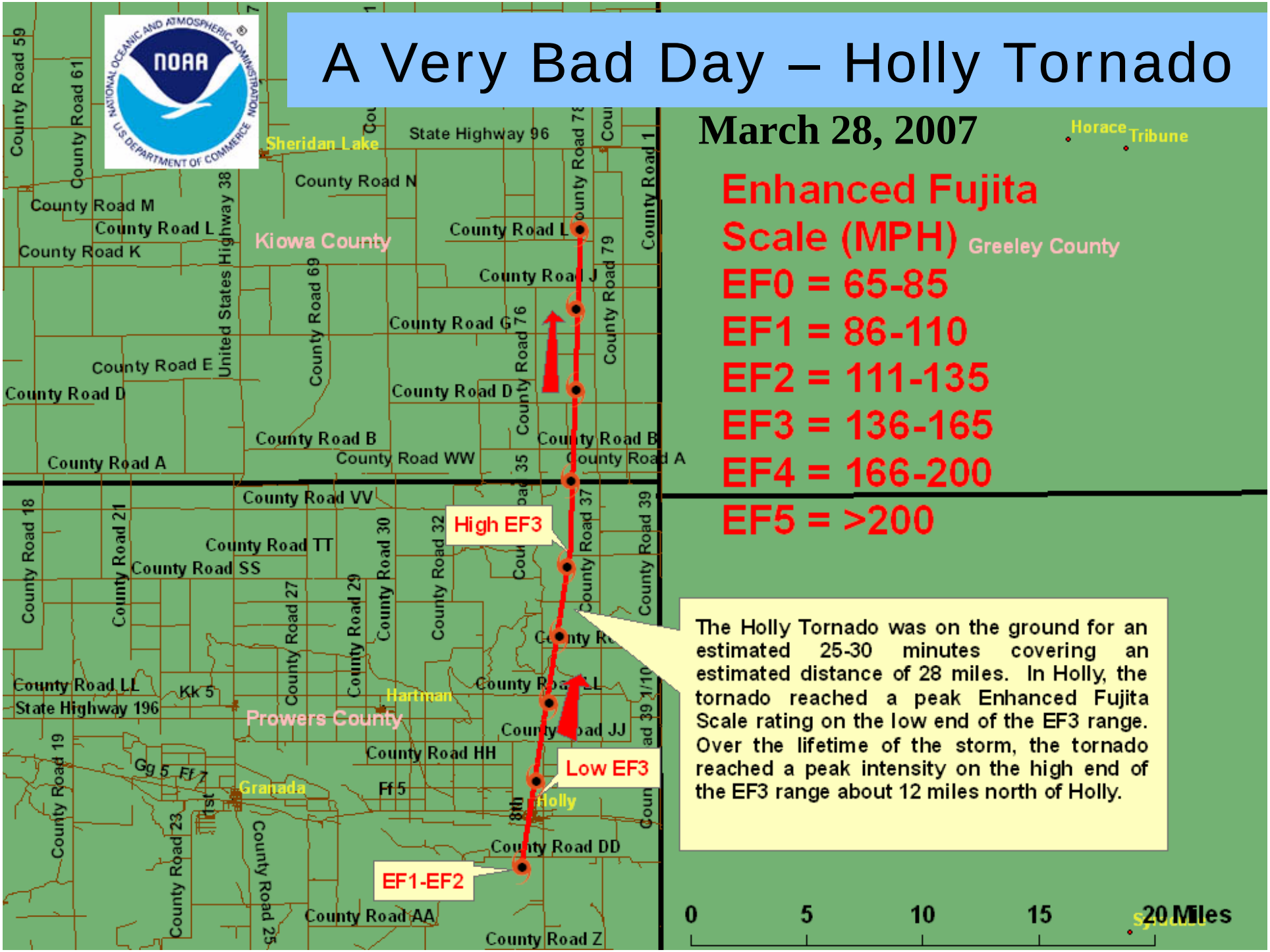


Yellow - water equivalent measured by coring/melting as reported by Cooperative Observers

Light Blue - water equivalent measured by coring/weighing as reported by NWS employees

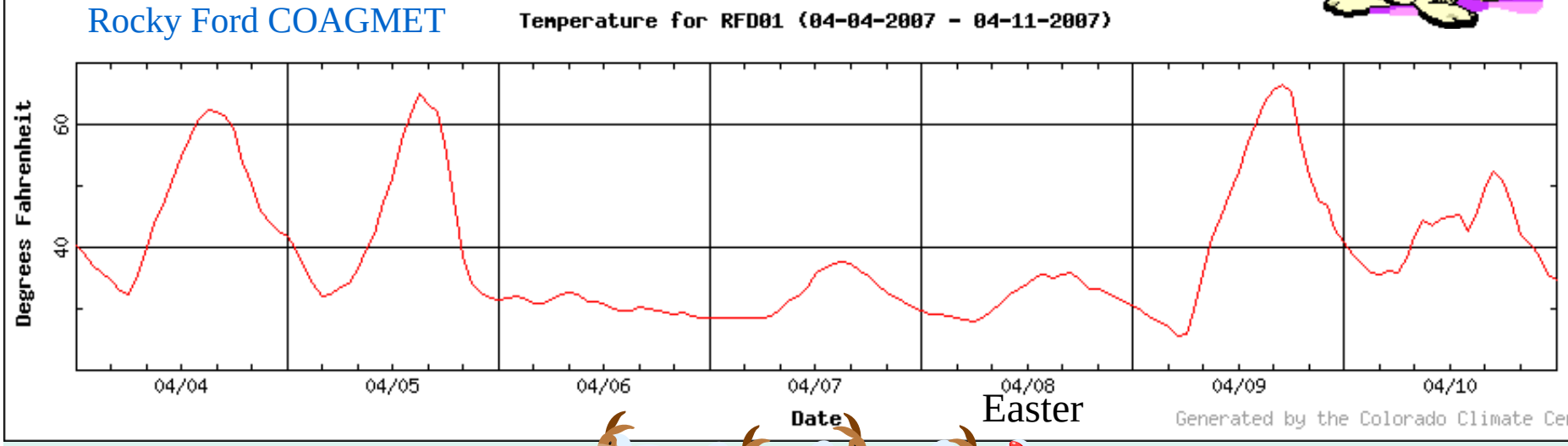
Boxed - total precipitation for December and January as reported by Cooperative Observers

http://www.crh.noaa.gov/crnews/display_story.php?wfo=pub&storyid=5870&source=0

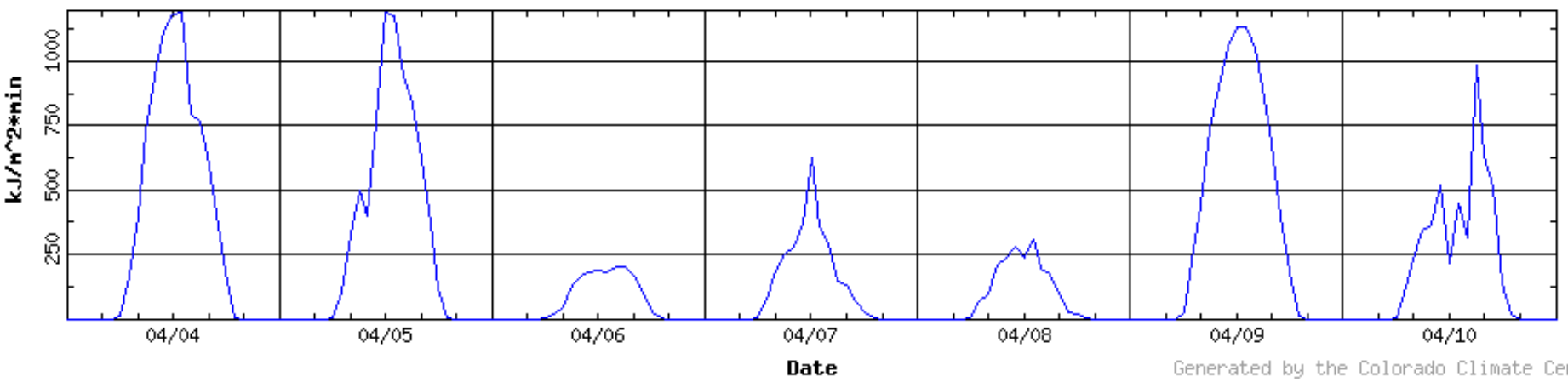

A Very Bad Day – Holly Tornado
March 28, 2007
Enhanced Fujita Scale (MPH)
EF0 = 65-85
EF1 = 86-110
EF2 = 111-135
EF3 = 136-165
EF4 = 166-200
EF5 = >200
High EF3
Low EF3
EF1-EF2
The Holly Tornado was on the ground for an estimated 25-30 minutes covering an estimated distance of 28 miles. In Holly, the tornado reached a peak Enhanced Fujita Scale rating on the low end of the EF3 range. Over the lifetime of the storm, the tornado reached a peak intensity on the high end of the EF3 range about 12 miles north of Holly.
Sheridan Lake
State Highway 96
Horace
Tribune
Kiowa County
Greeley County
Hartman
Prowers County
Granada
Holly
0 5 10 15 20 Miles

A Cold Easter

Rocky Ford COAGMET



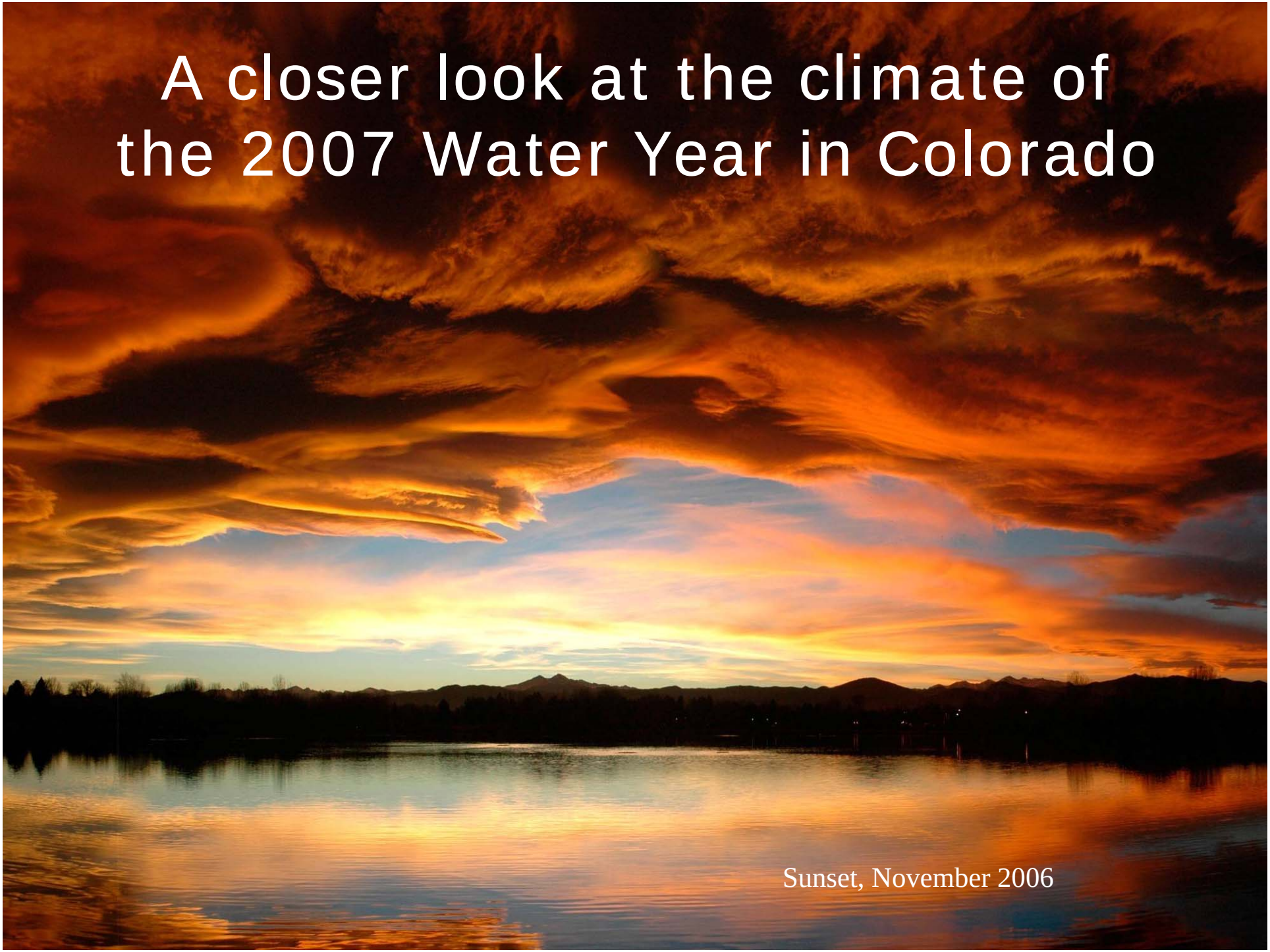
Rocky Ford COAGMET



Highlights of Water Year 2007

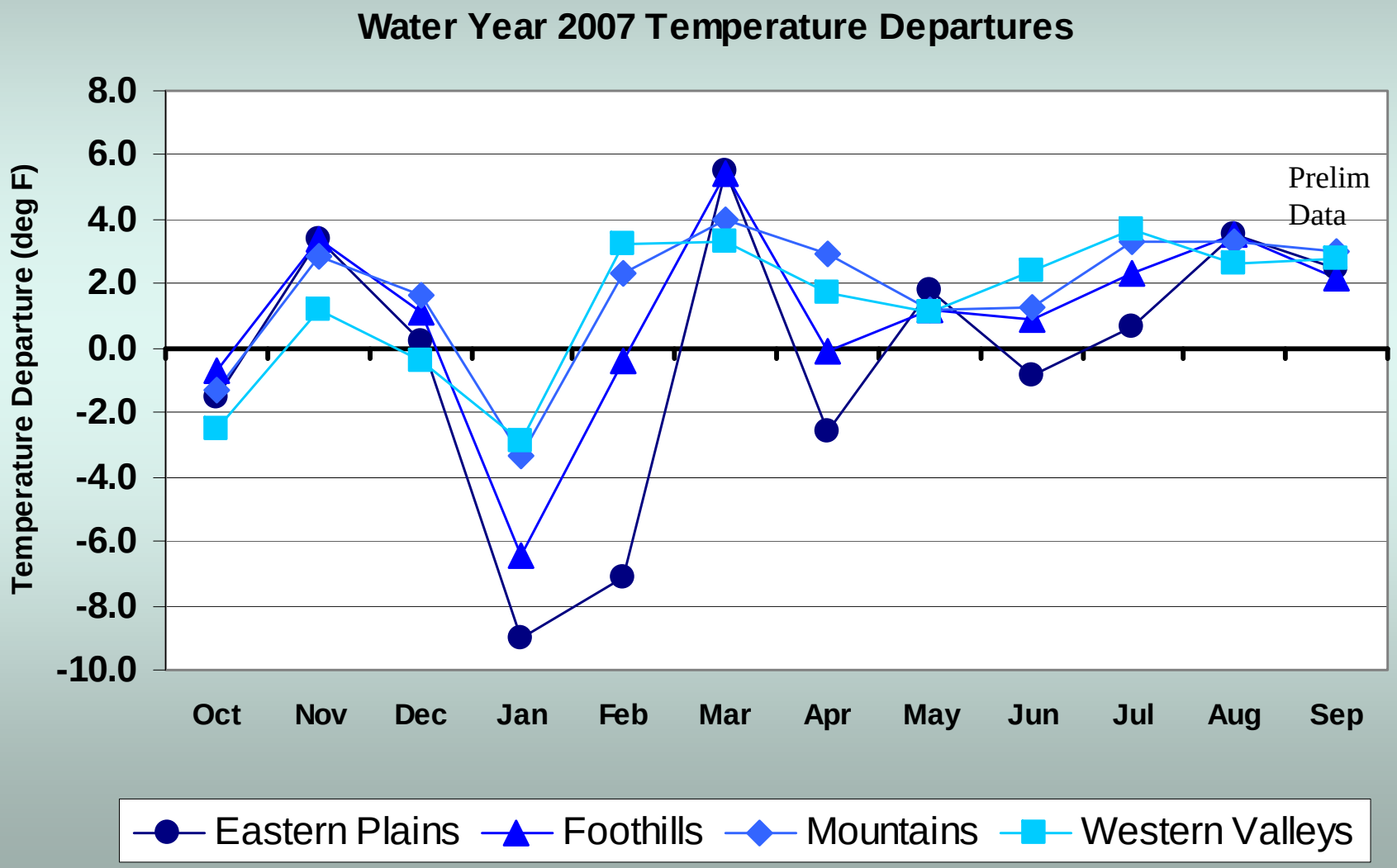
- Wet October 2006
- December 2006 Snowstorms
- Persisting snowcover and cold (E. Plains)
- Holly tornado March 28, 2007
- Early snowmelt and dry May 07
- Hot summer with spotty storms
- September rains especially West Slope

A closer look at the climate of the 2007 Water Year in Colorado



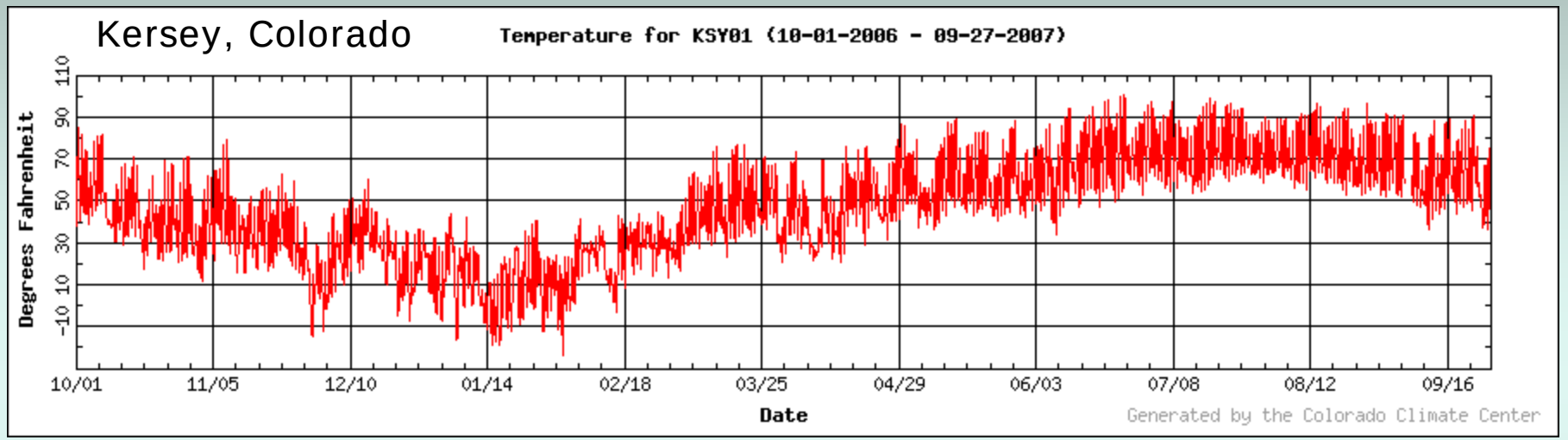
Sunset, November 2006

Water Year 2007 Temperature Departures from 1971-2000 average

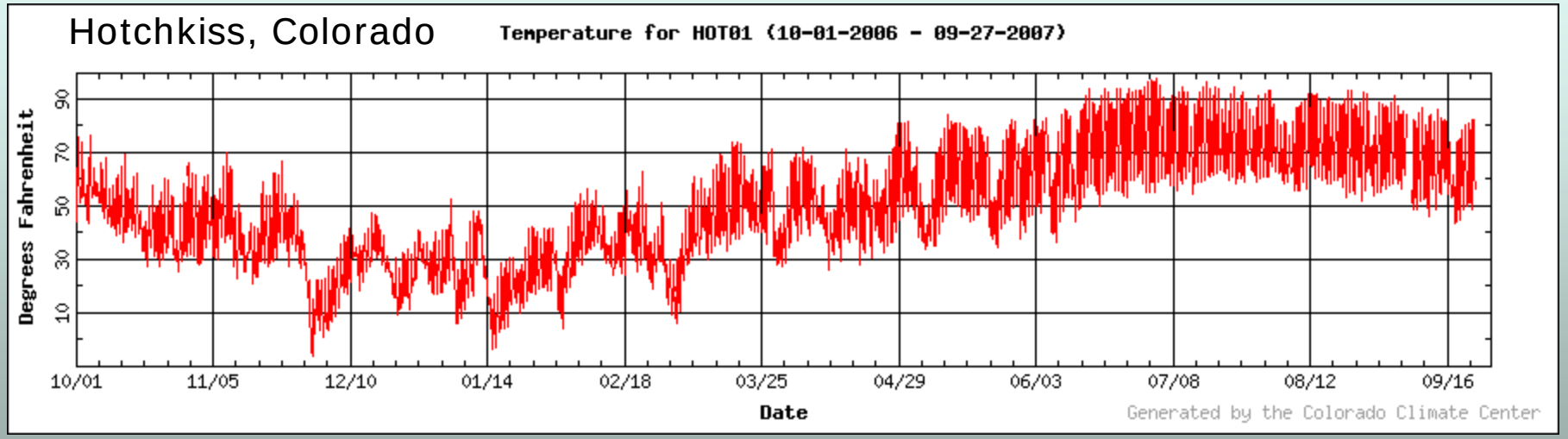


CoAgMet Temperatures

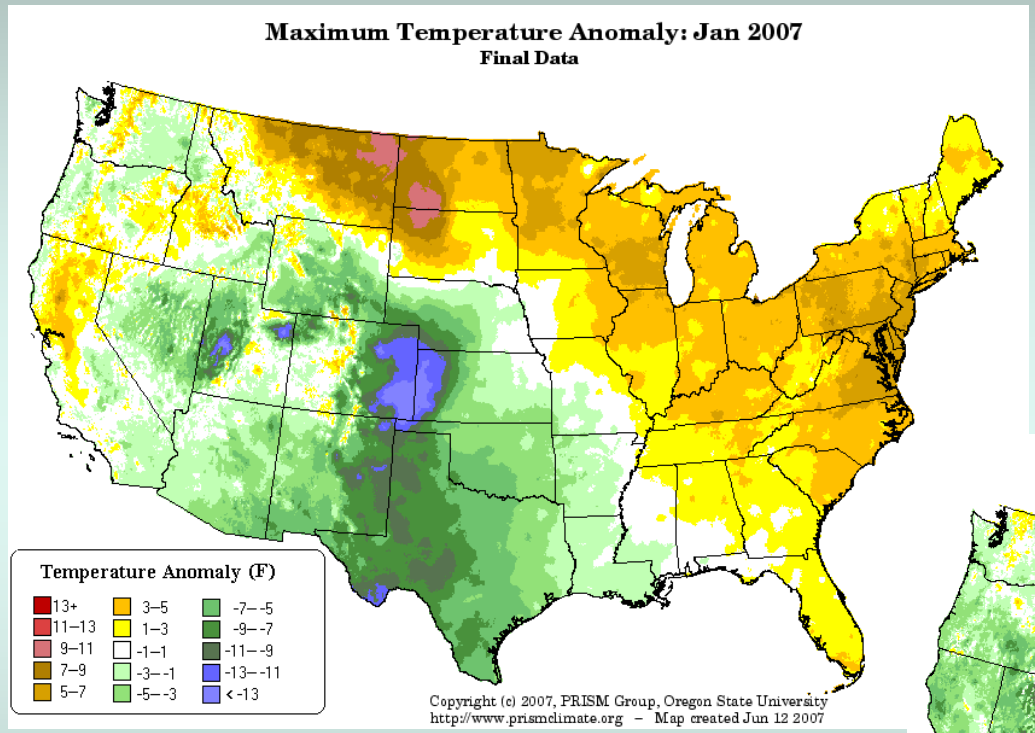
Kersey, Colorado

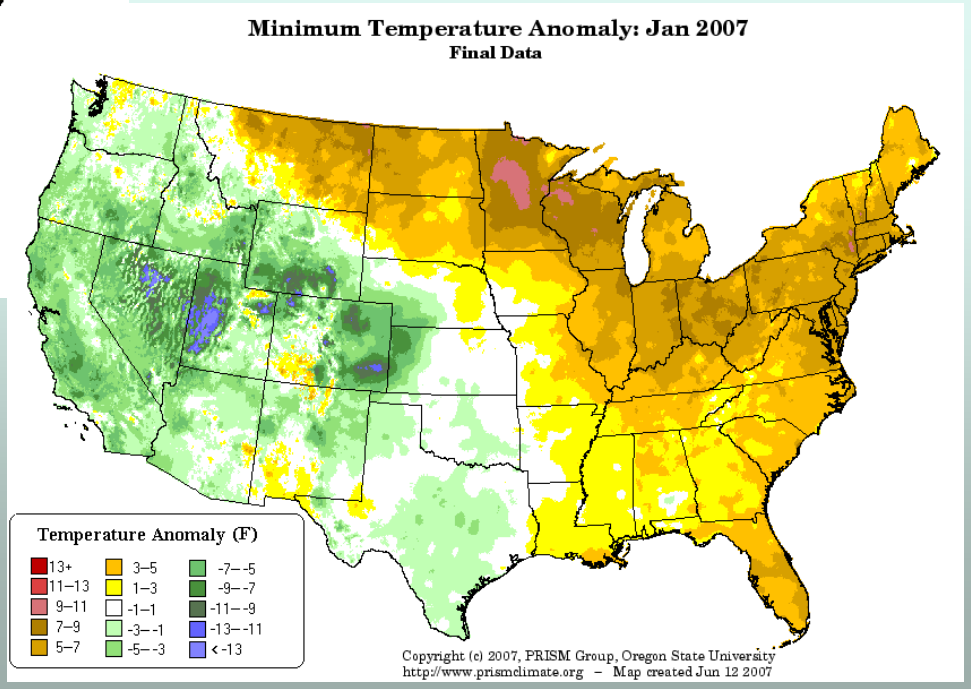


Hotchkiss, Colorado

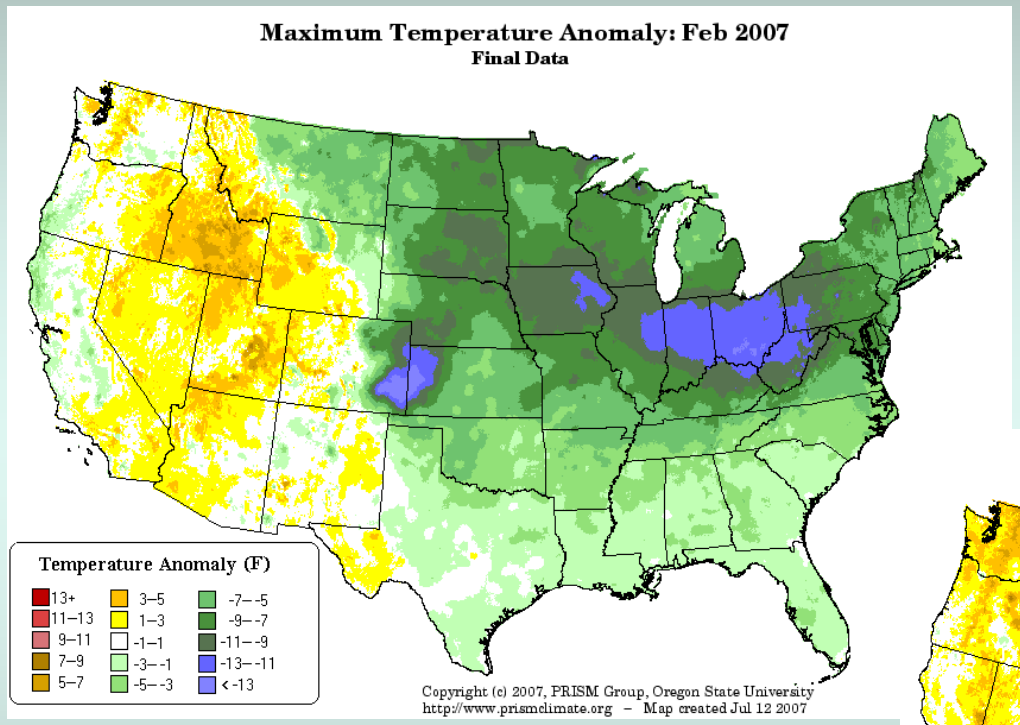


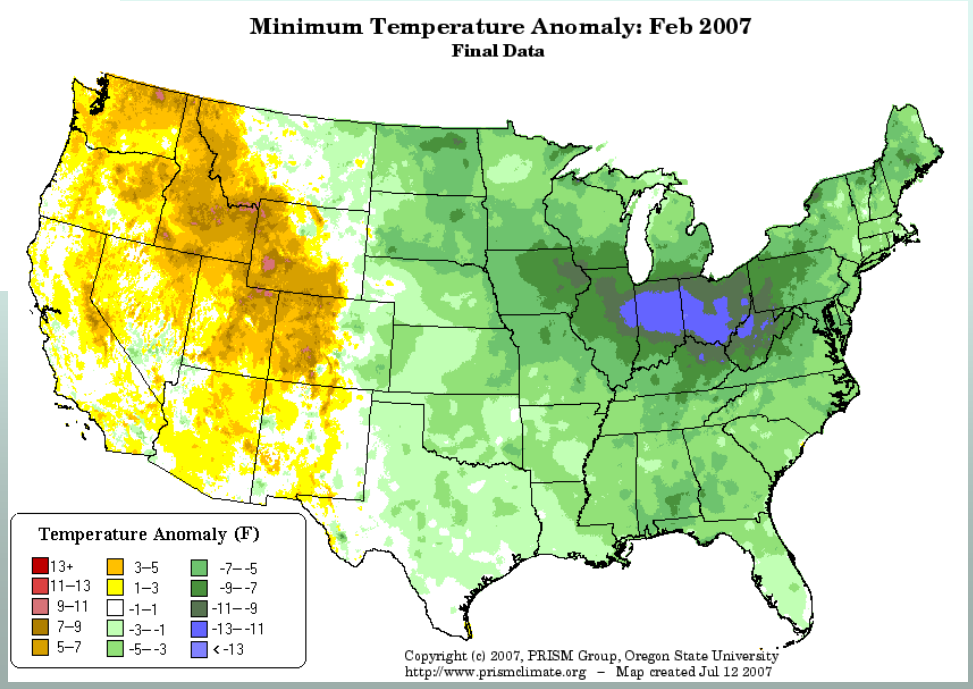
January 2007 temperature departure from average (Prism)





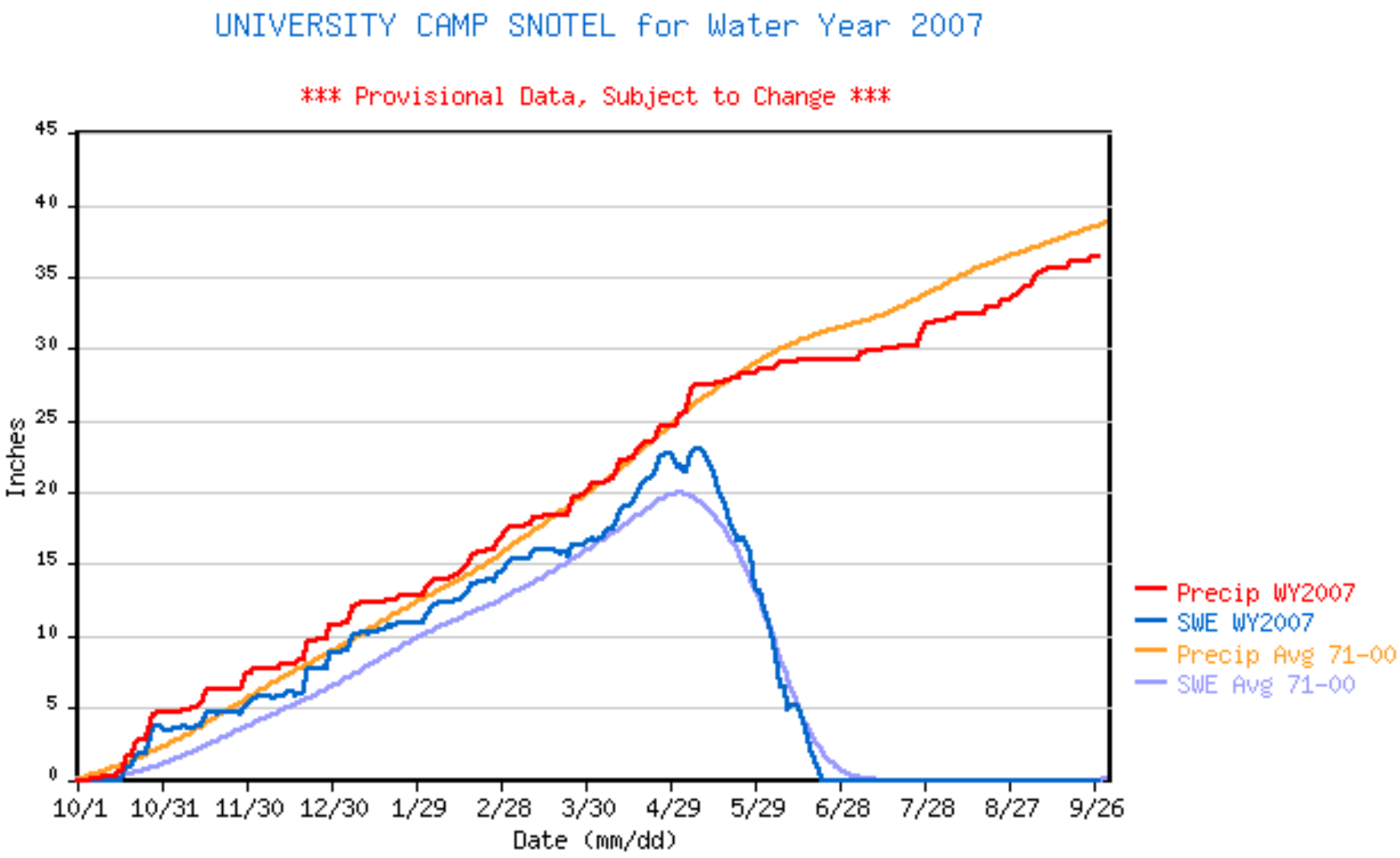
February 2007 temperature departure from average (Prism)



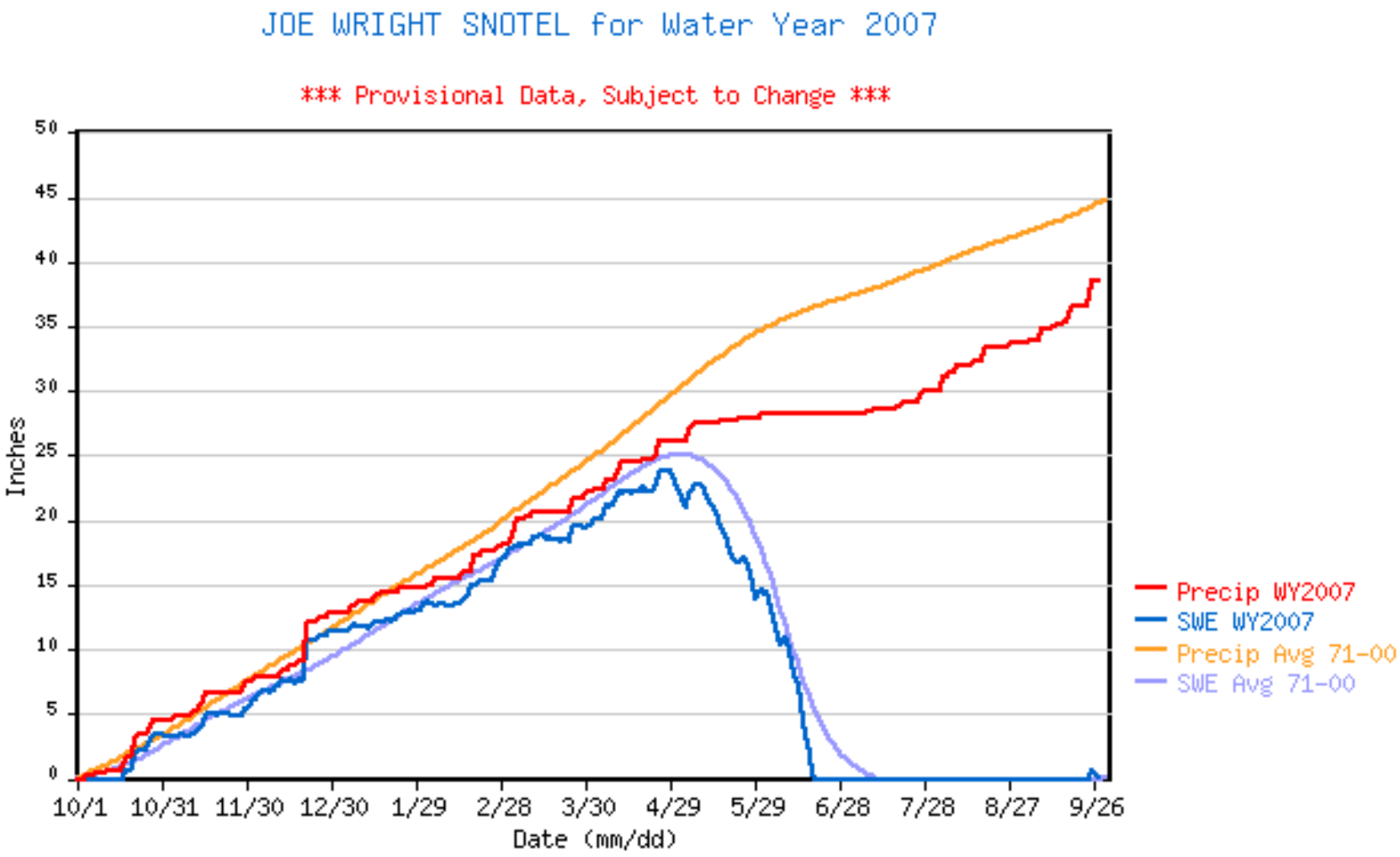


WY2007 Snowpack Accumulation and Meltout

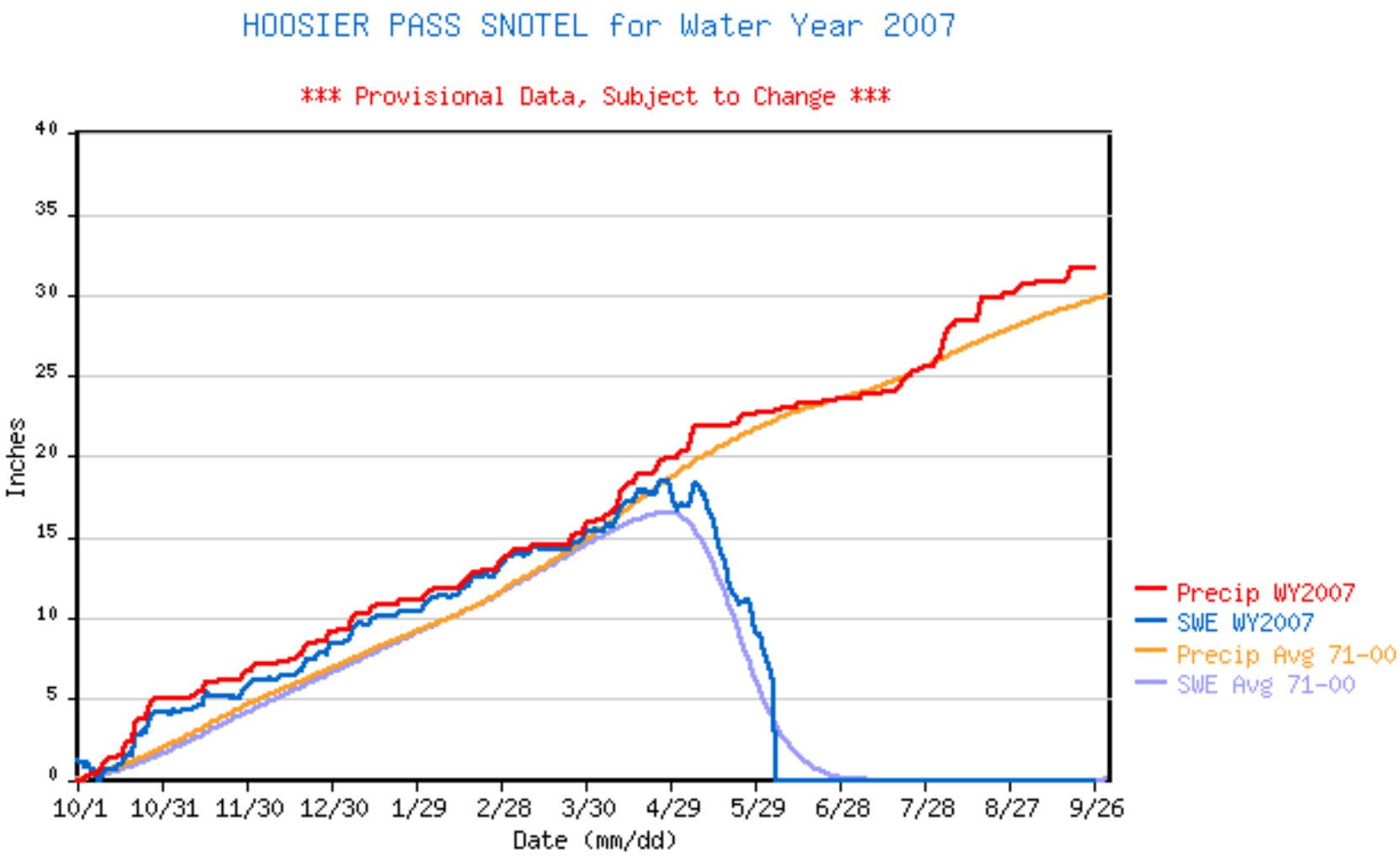
University Camp Snotel



Joe Wright Reservoir Snotel

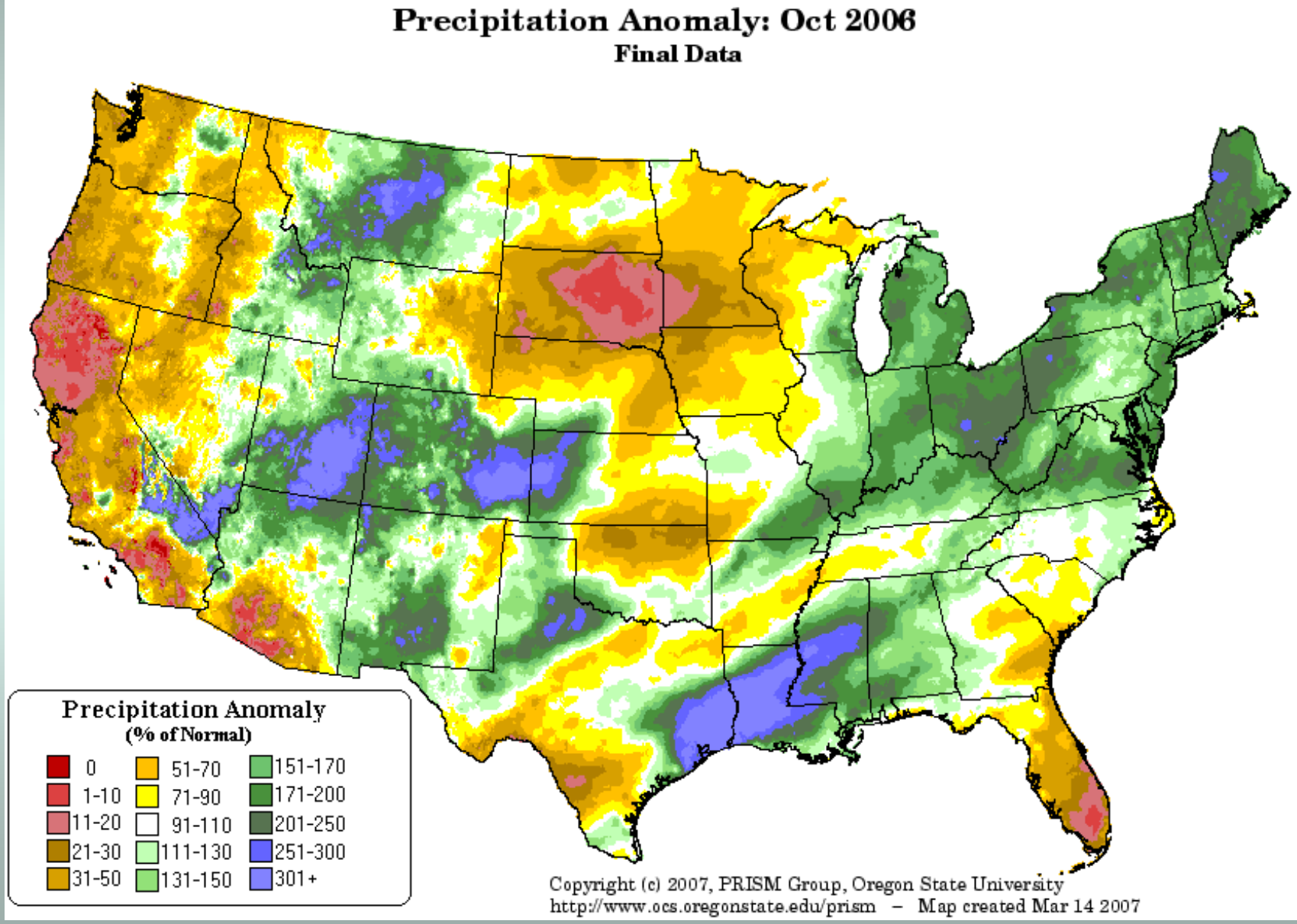


Hoosier Pass Snotel

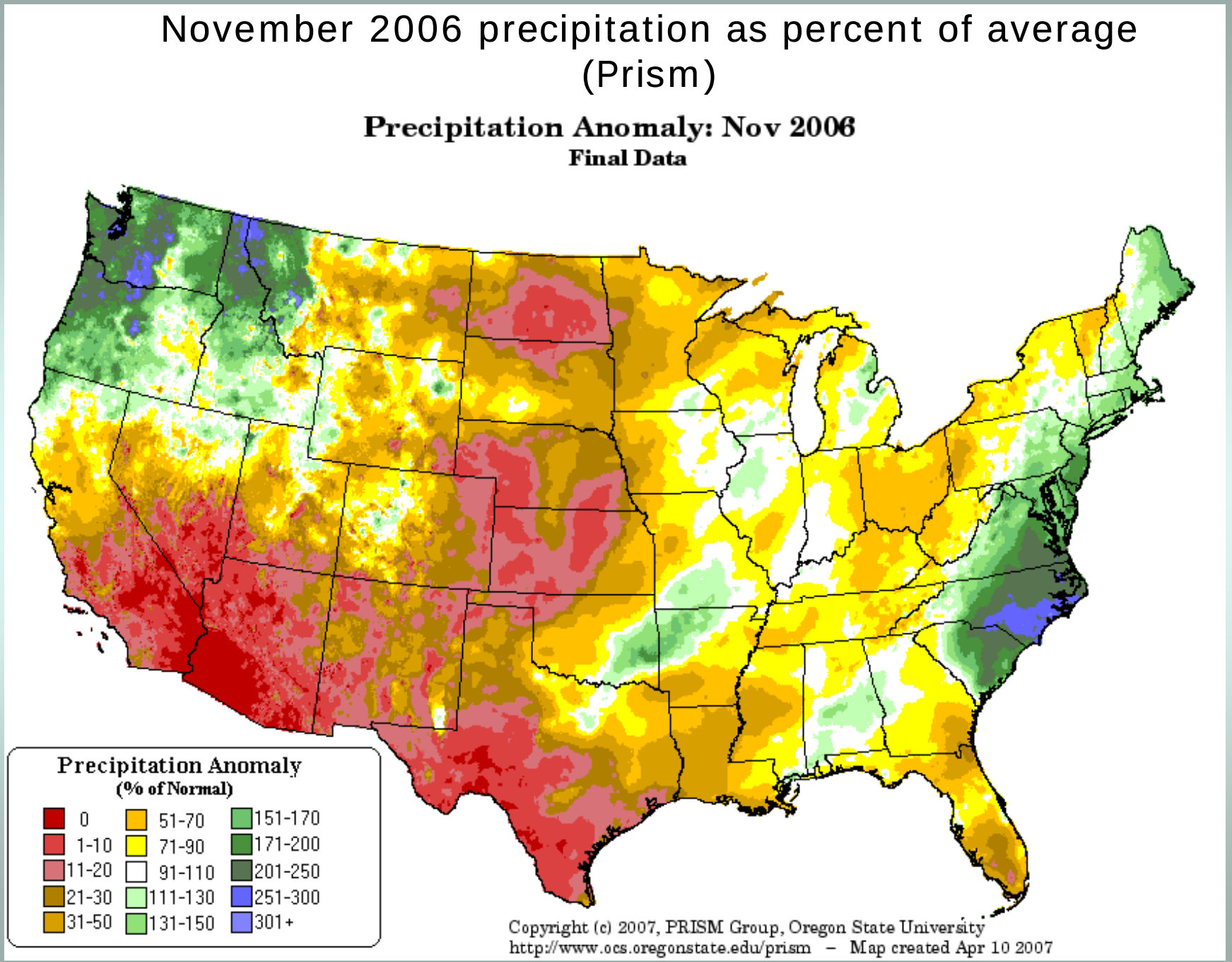


Month by Month Precipitation

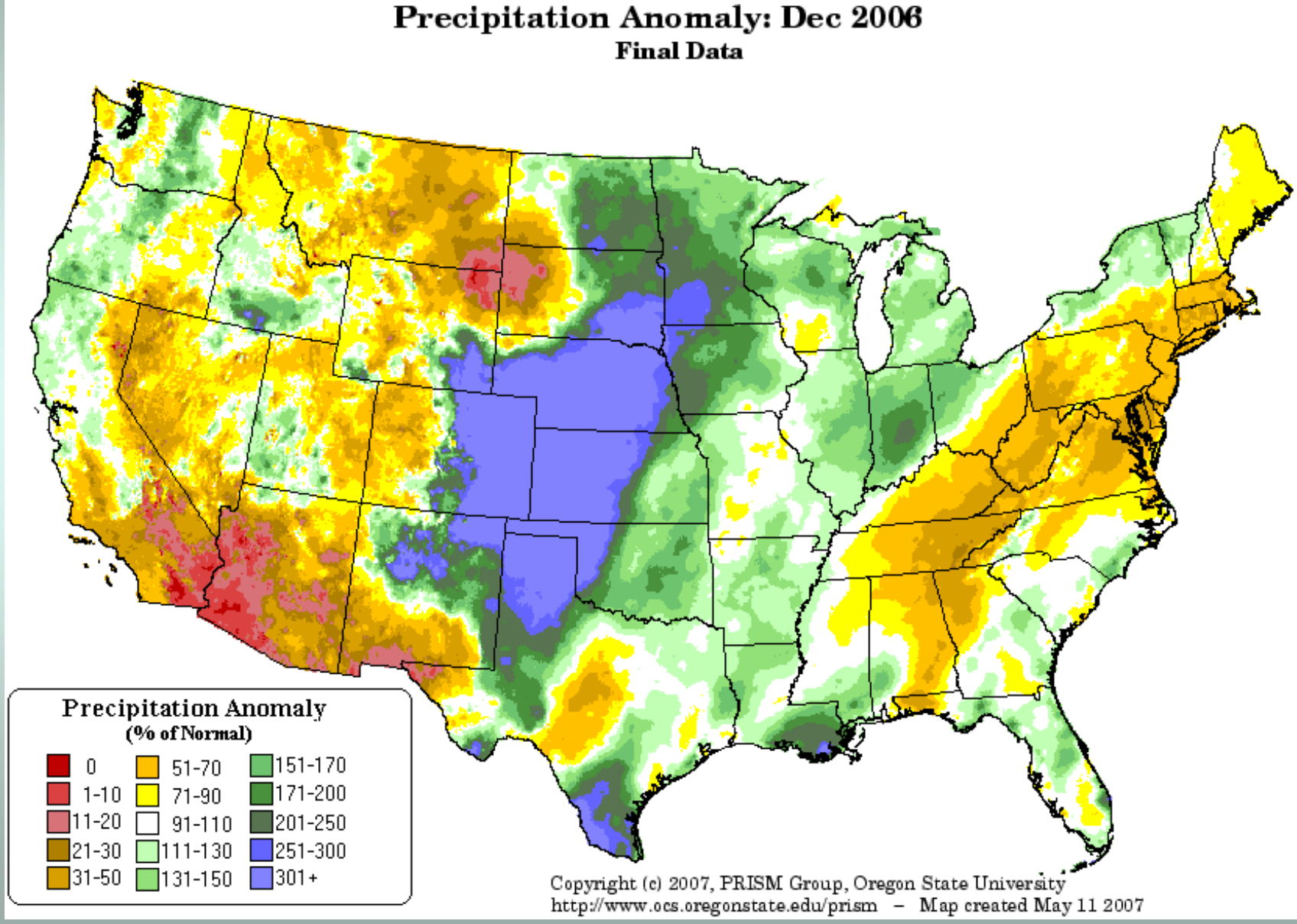
October 2006 precipitation as percent of average (Prism)



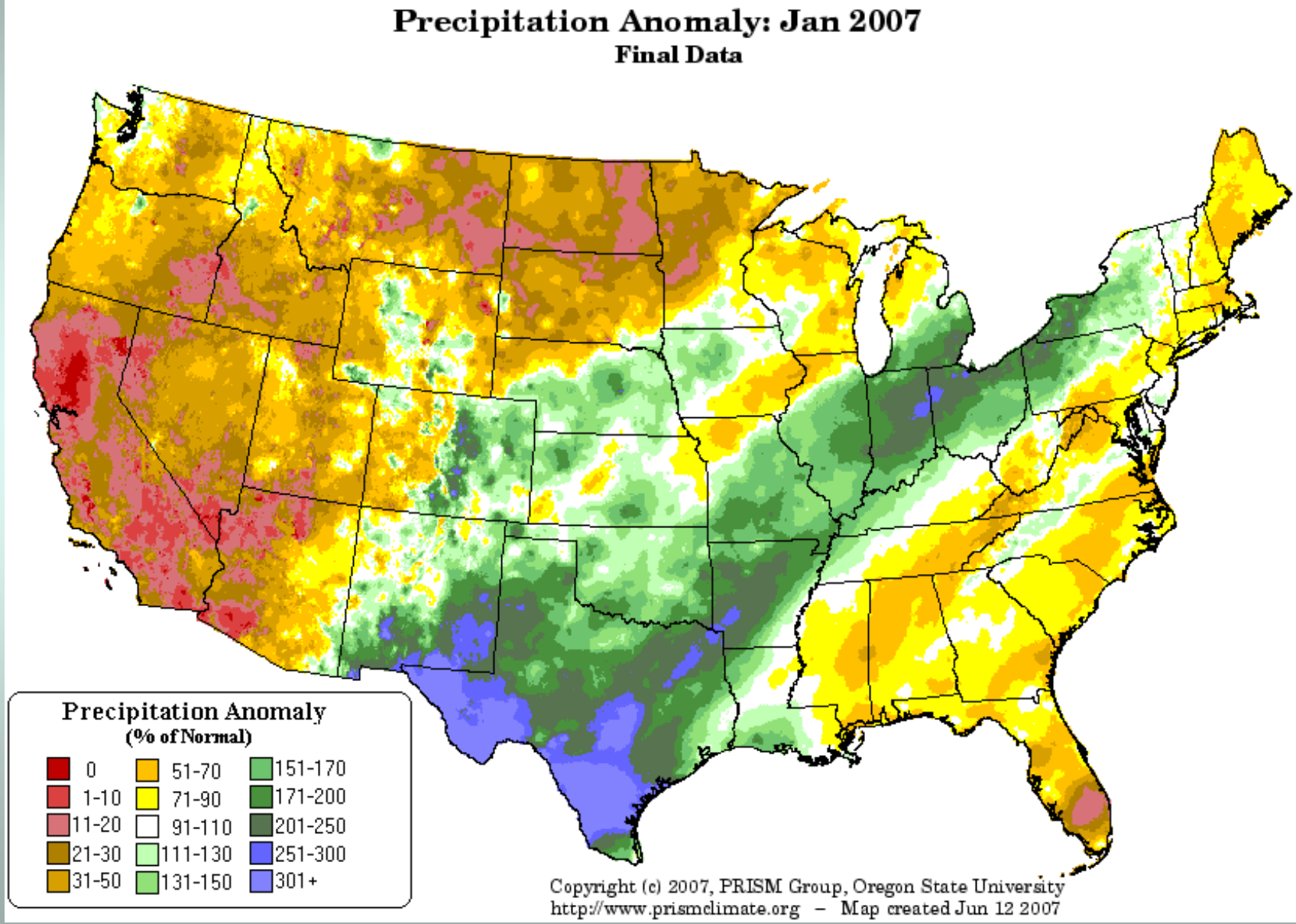
November 2006 precipitation as percent of average (Prism)



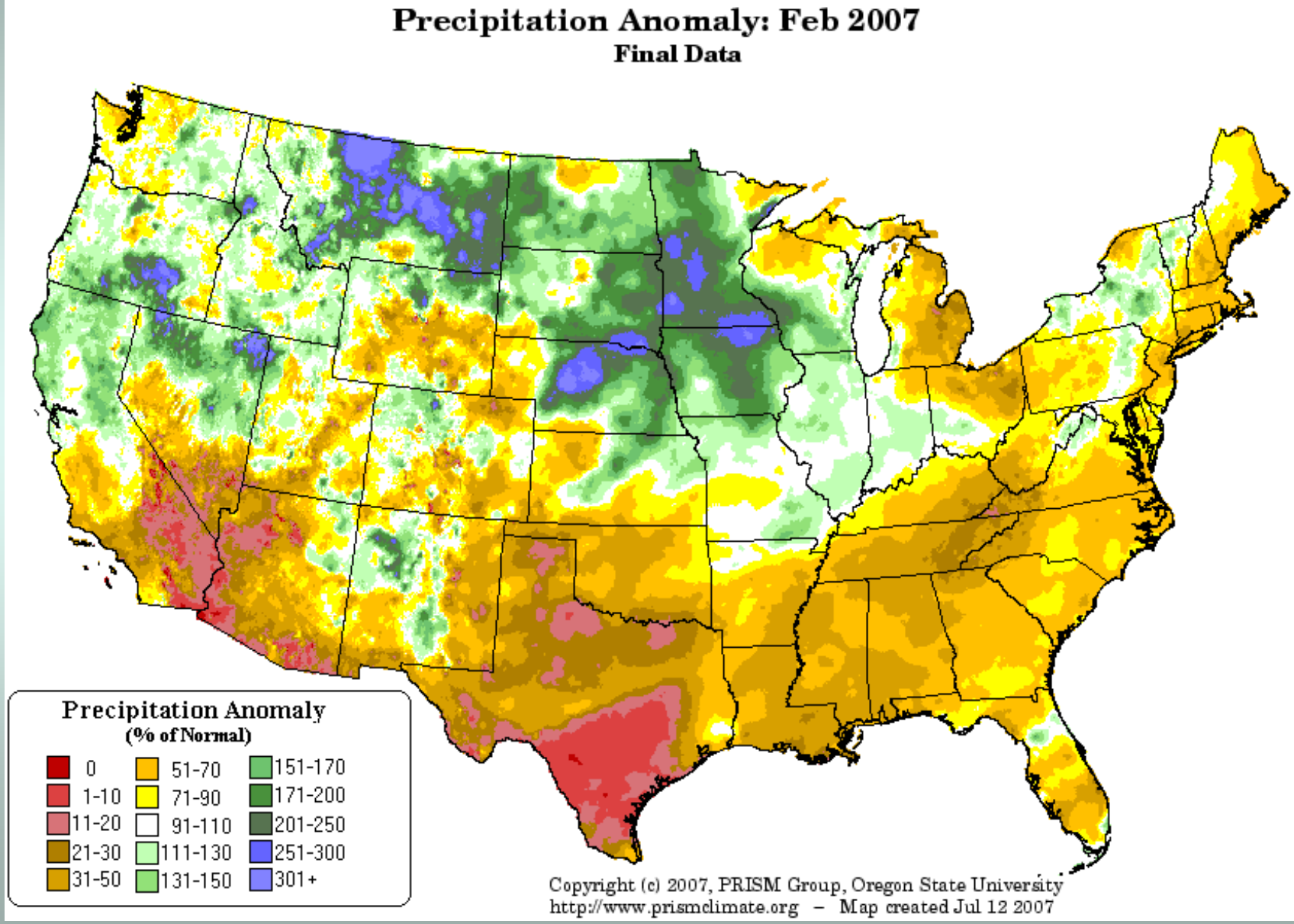
December 2006 precipitation as a percent of average (Prism)



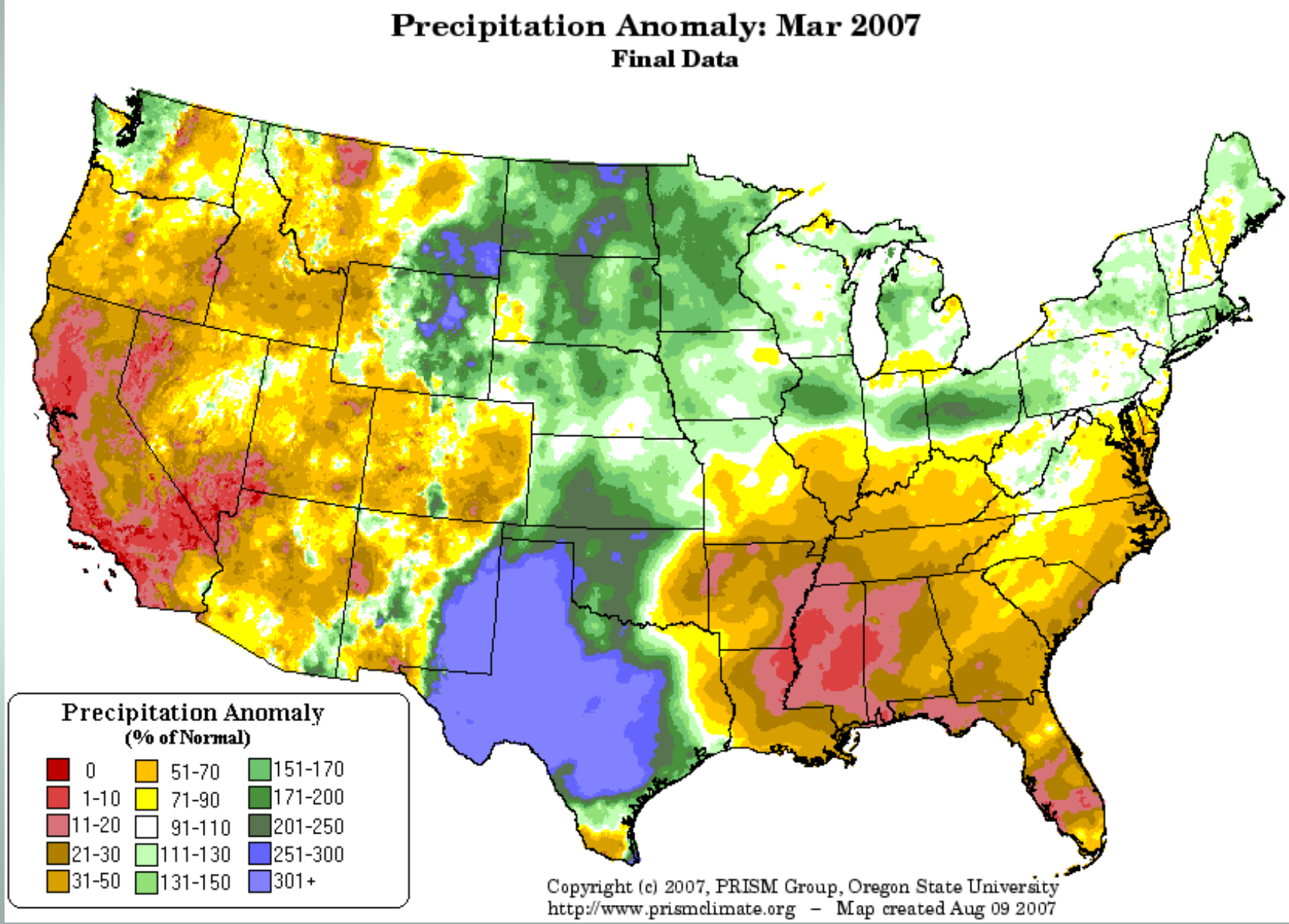
January 2007 precipitation as a percent of average (Prism)



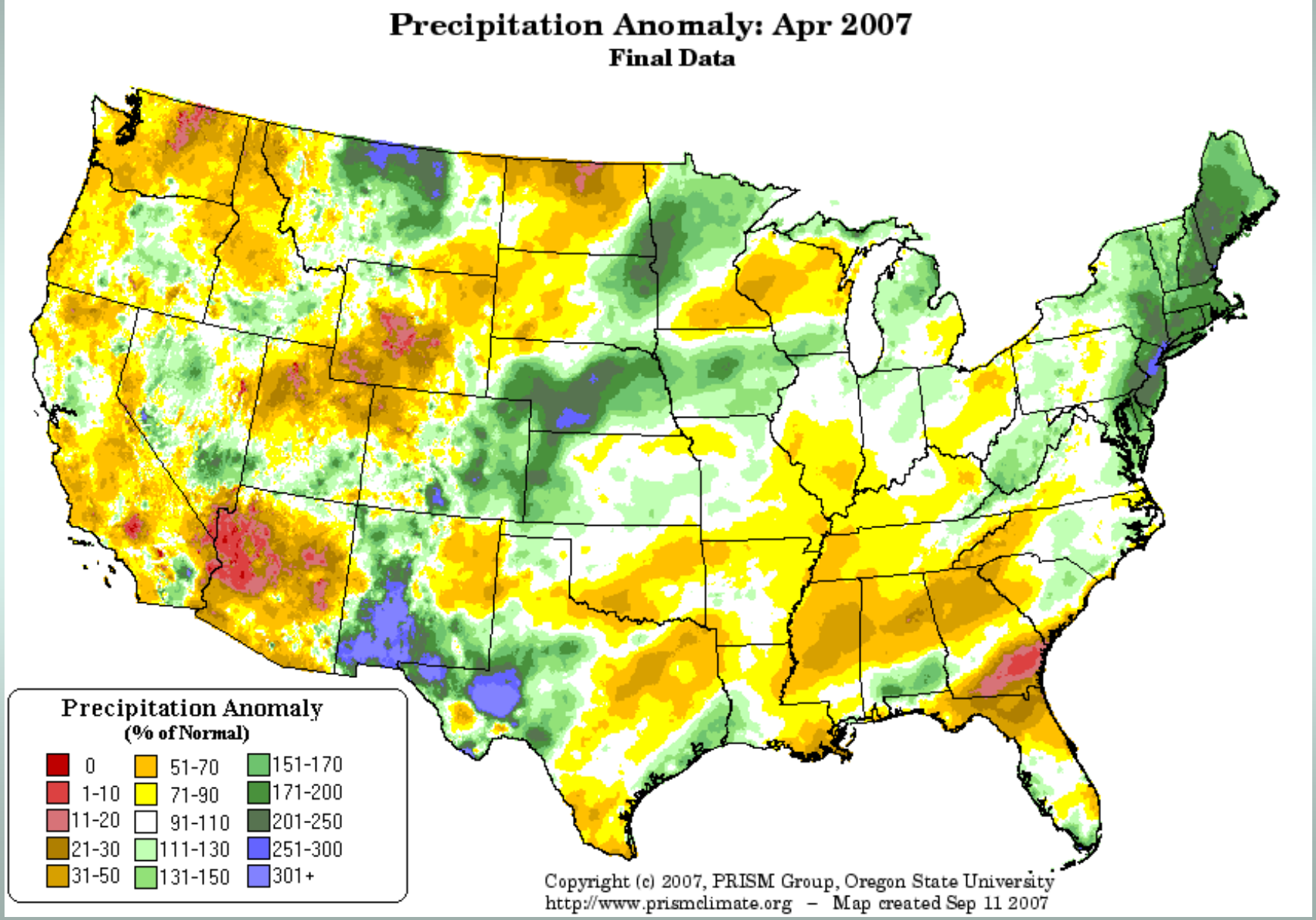
February 2007 precipitation as a percent of average (Prism)



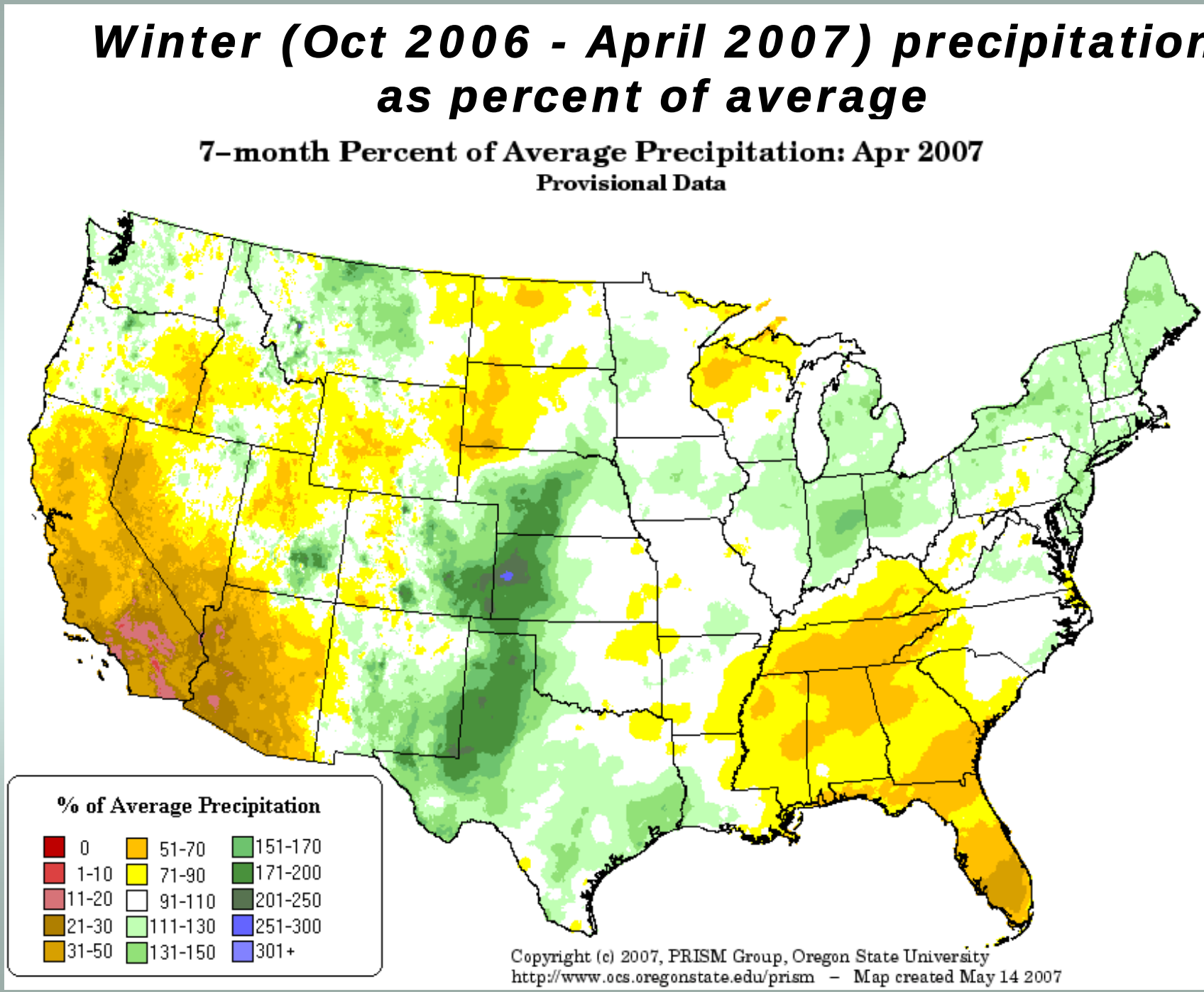
March 2007 precipitation as a percent of average (Prism)



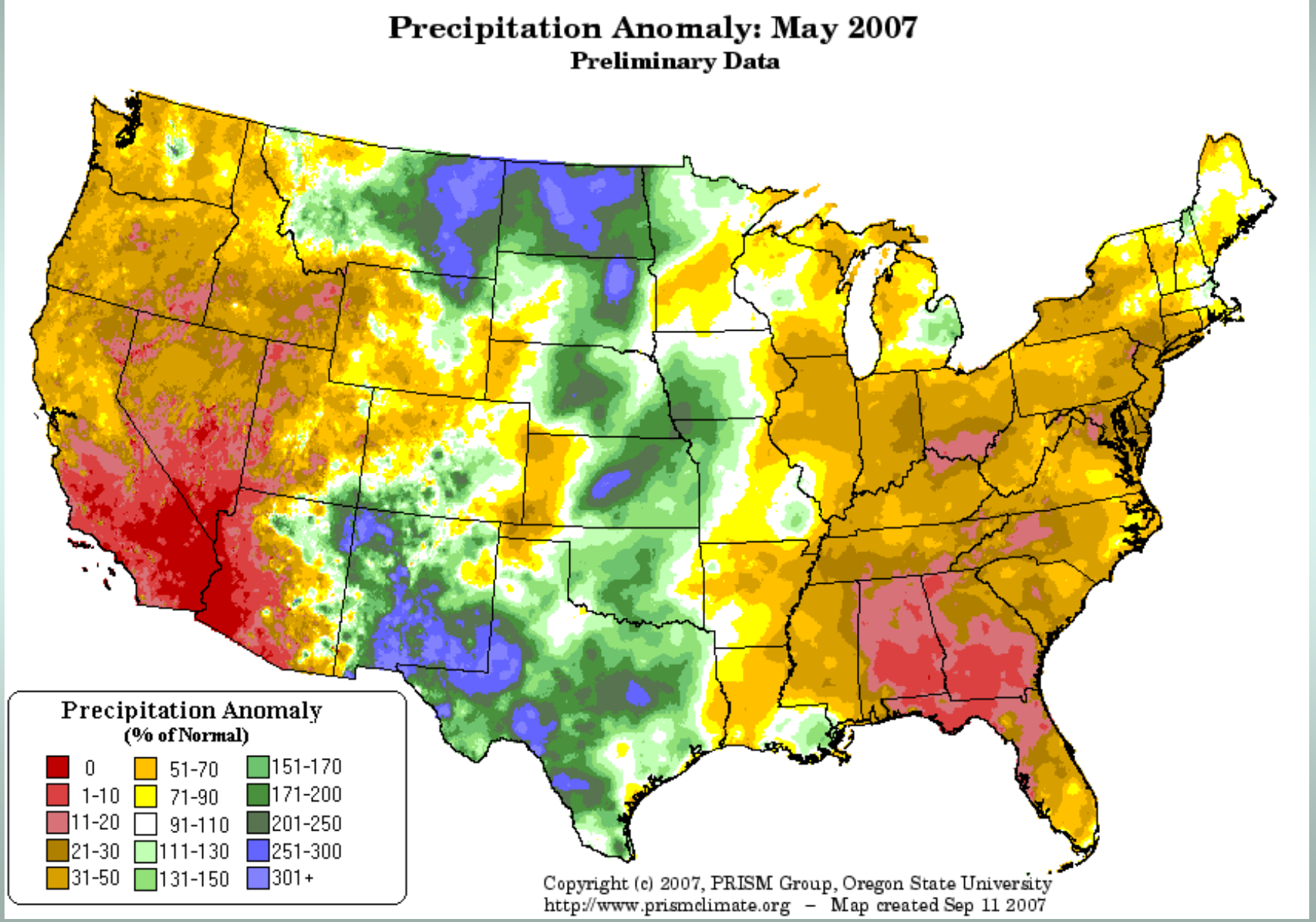
April 2007 precipitation as a percent of average (Prism)



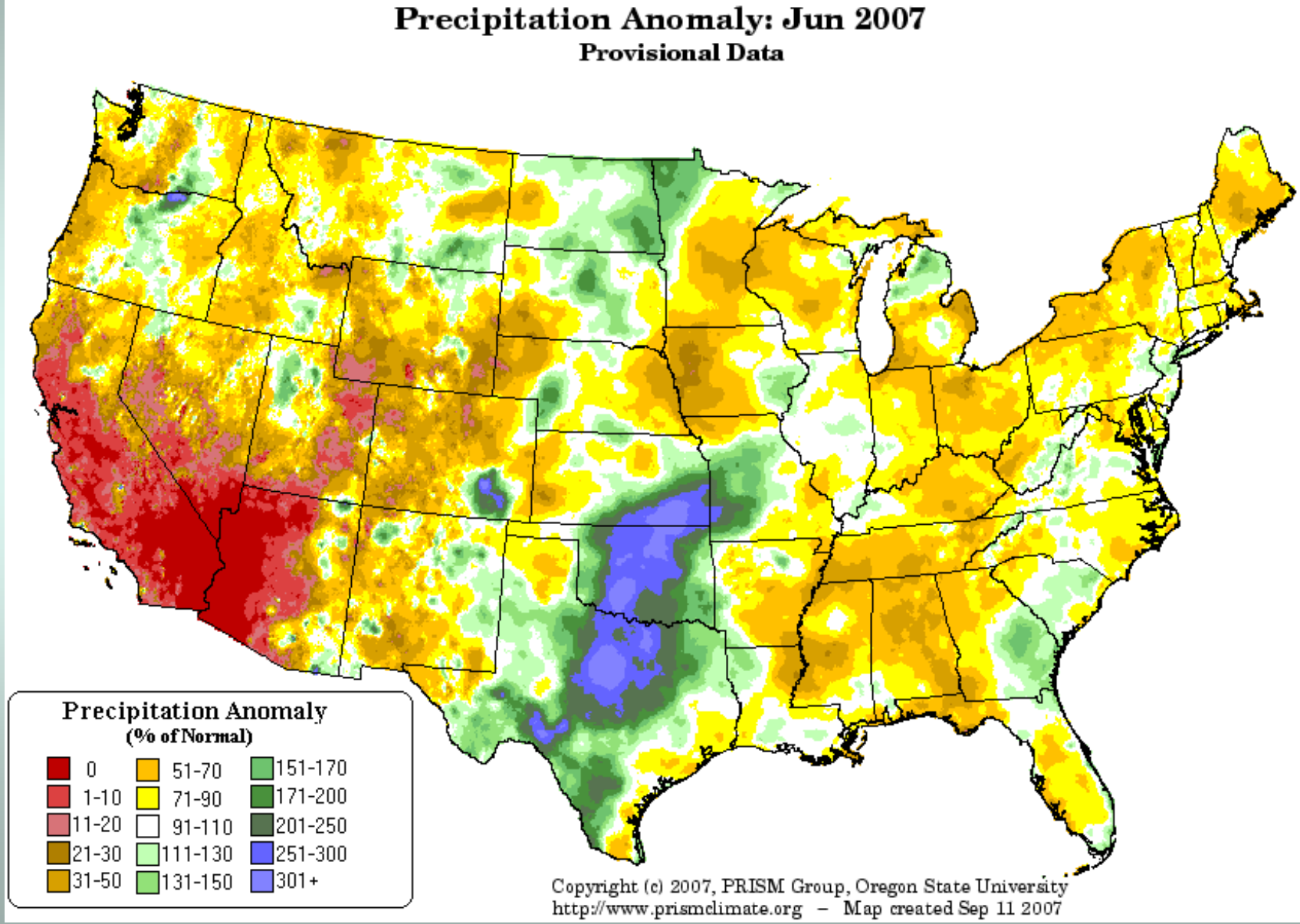
Winter (Oct 2006 - April 2007) precipitation as percent of average



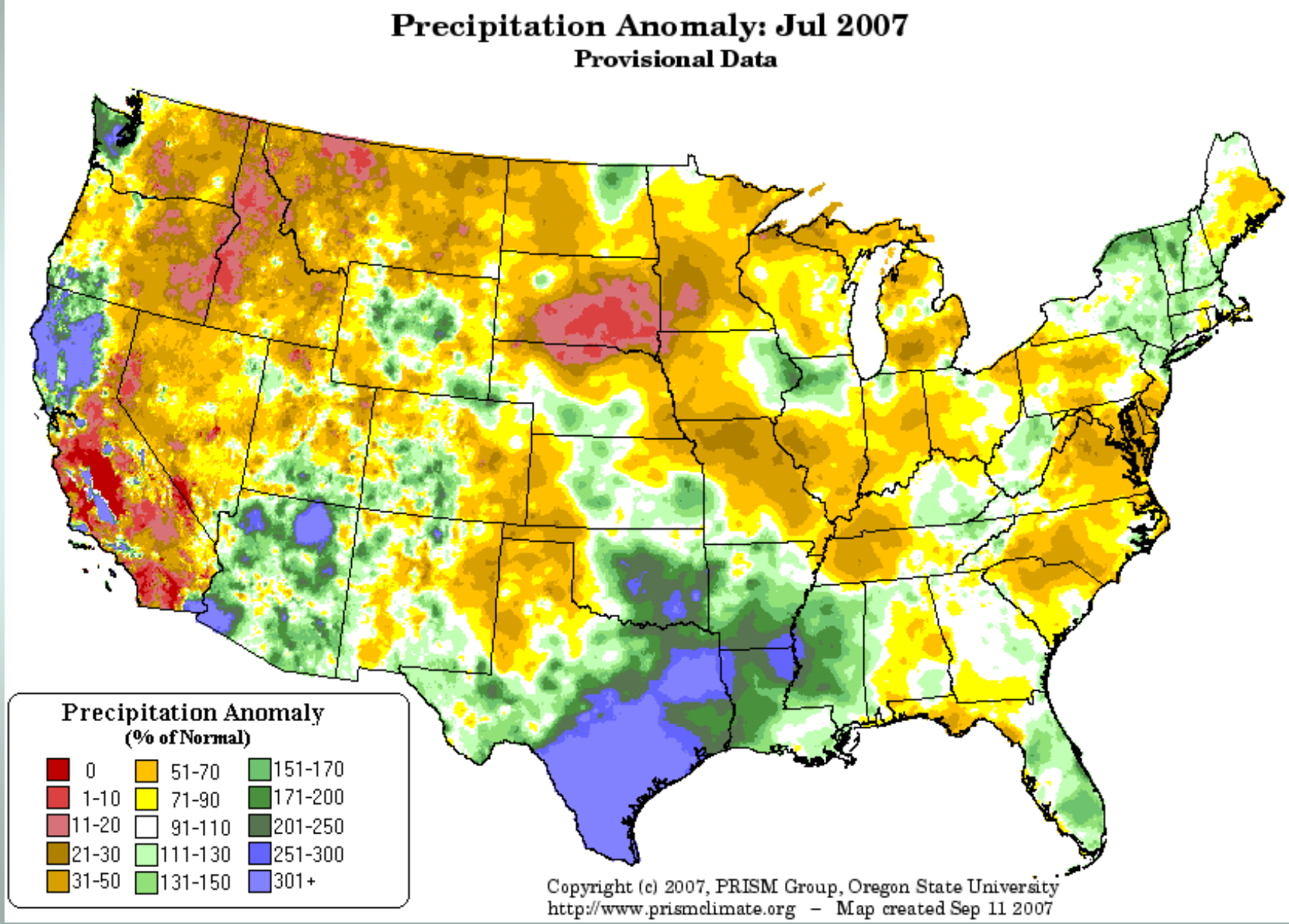
May 2007 precipitation as a percent of average (Prism)



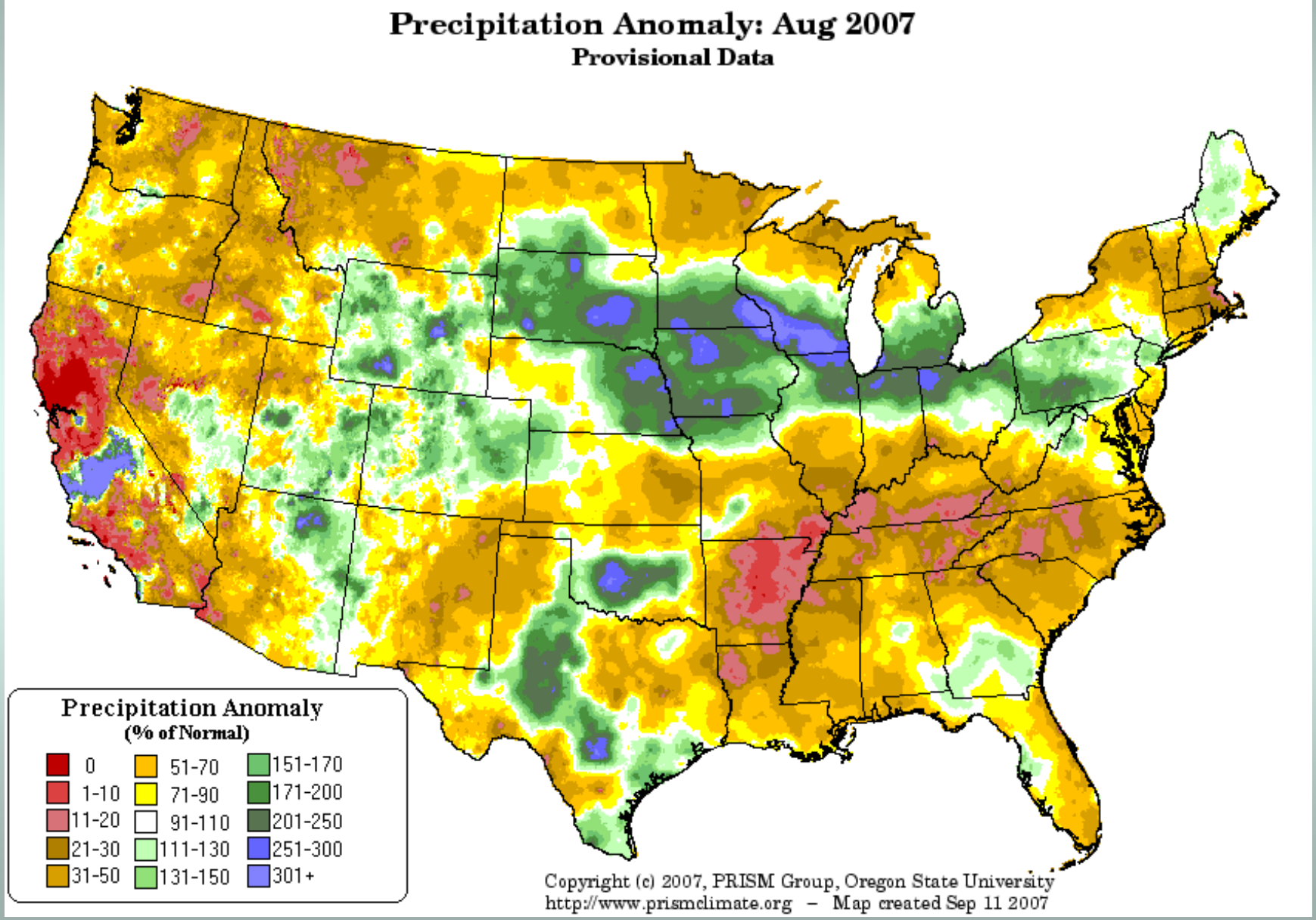
June 2007 precipitation as a percent of average (Prism)



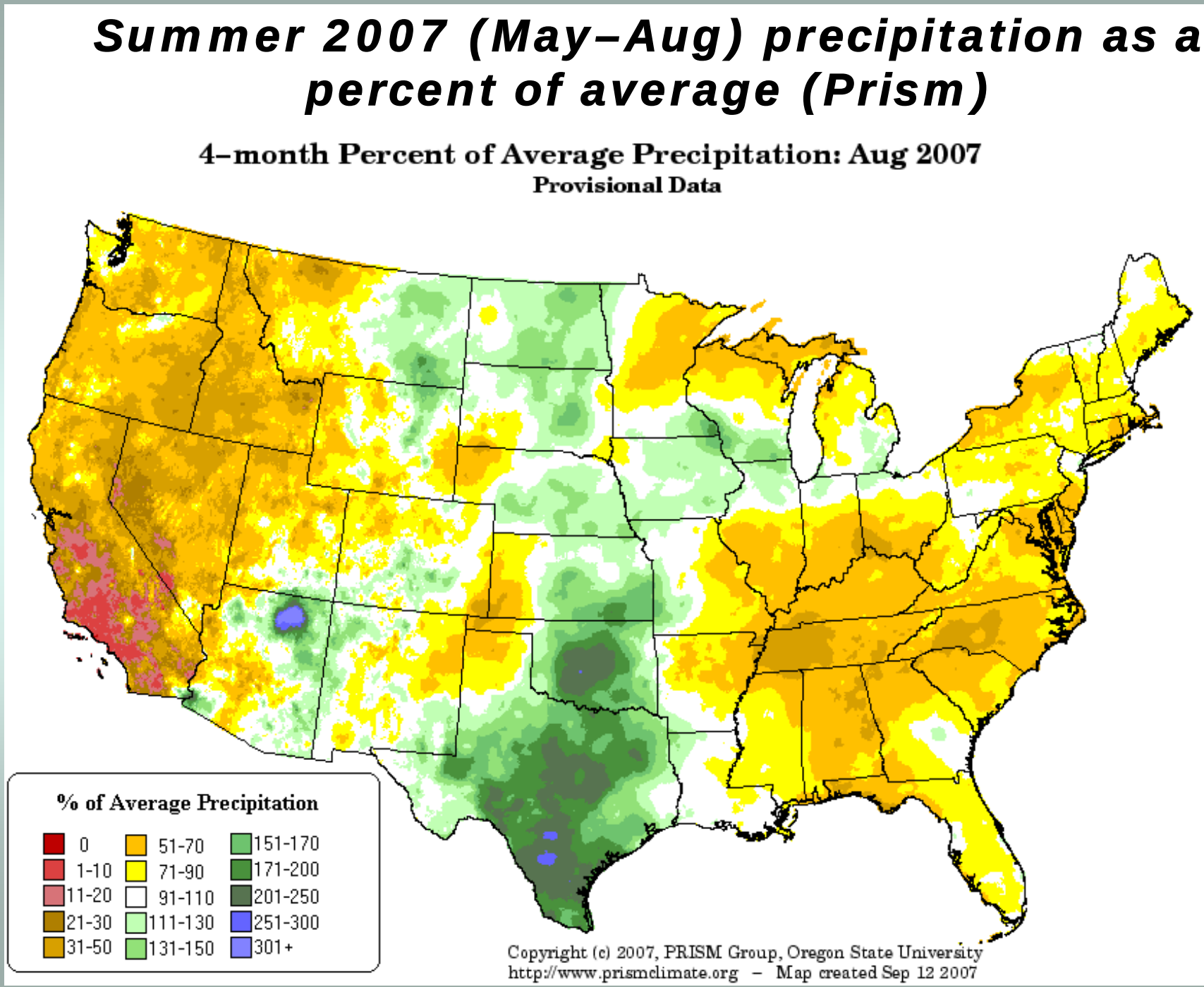
July 2007 precipitation as a percent of average (Prism)



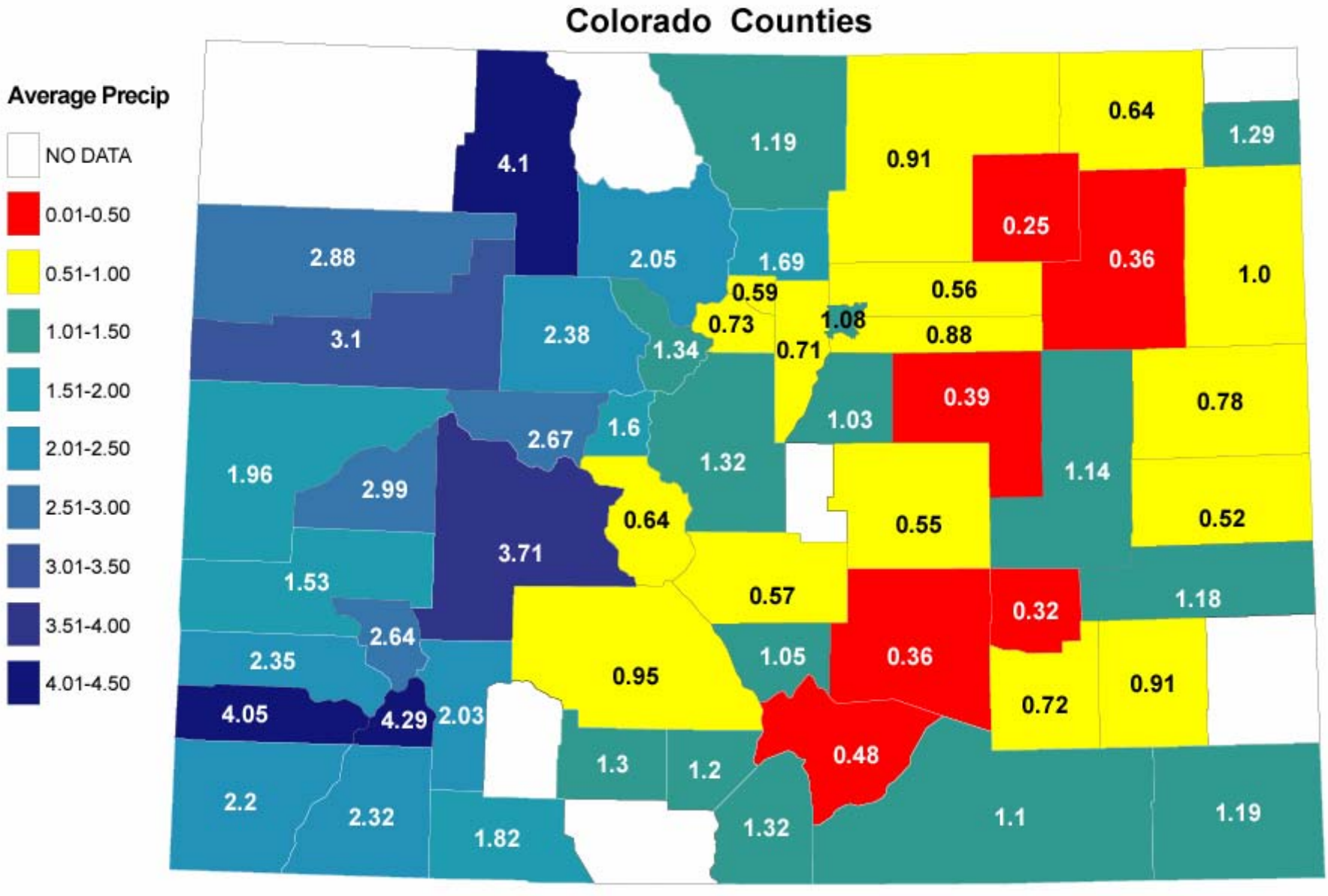
August 2007 precipitation as a percent of average (Prism)



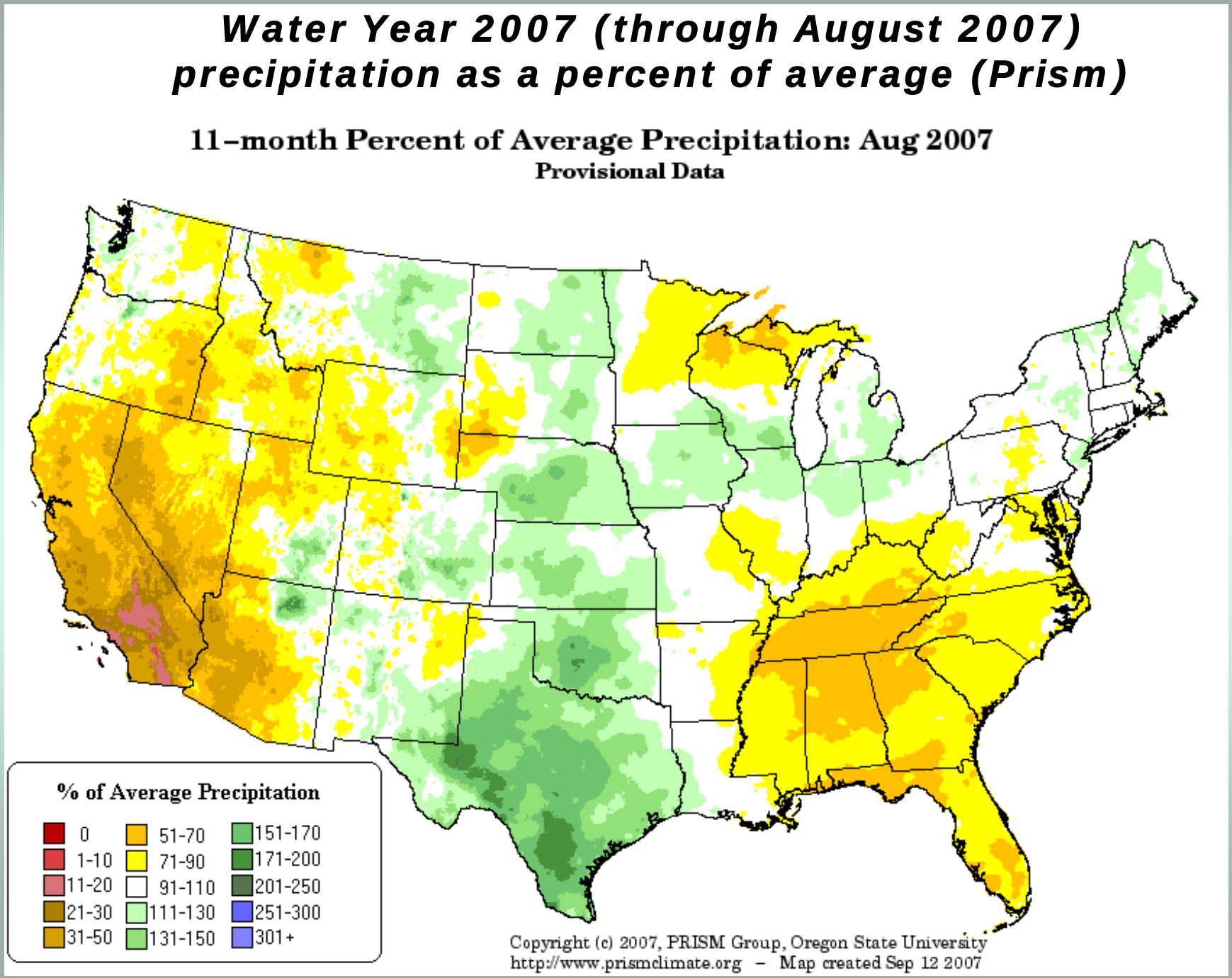
Summer 2007 (May–Aug) precipitation as a percent of average (Prism)



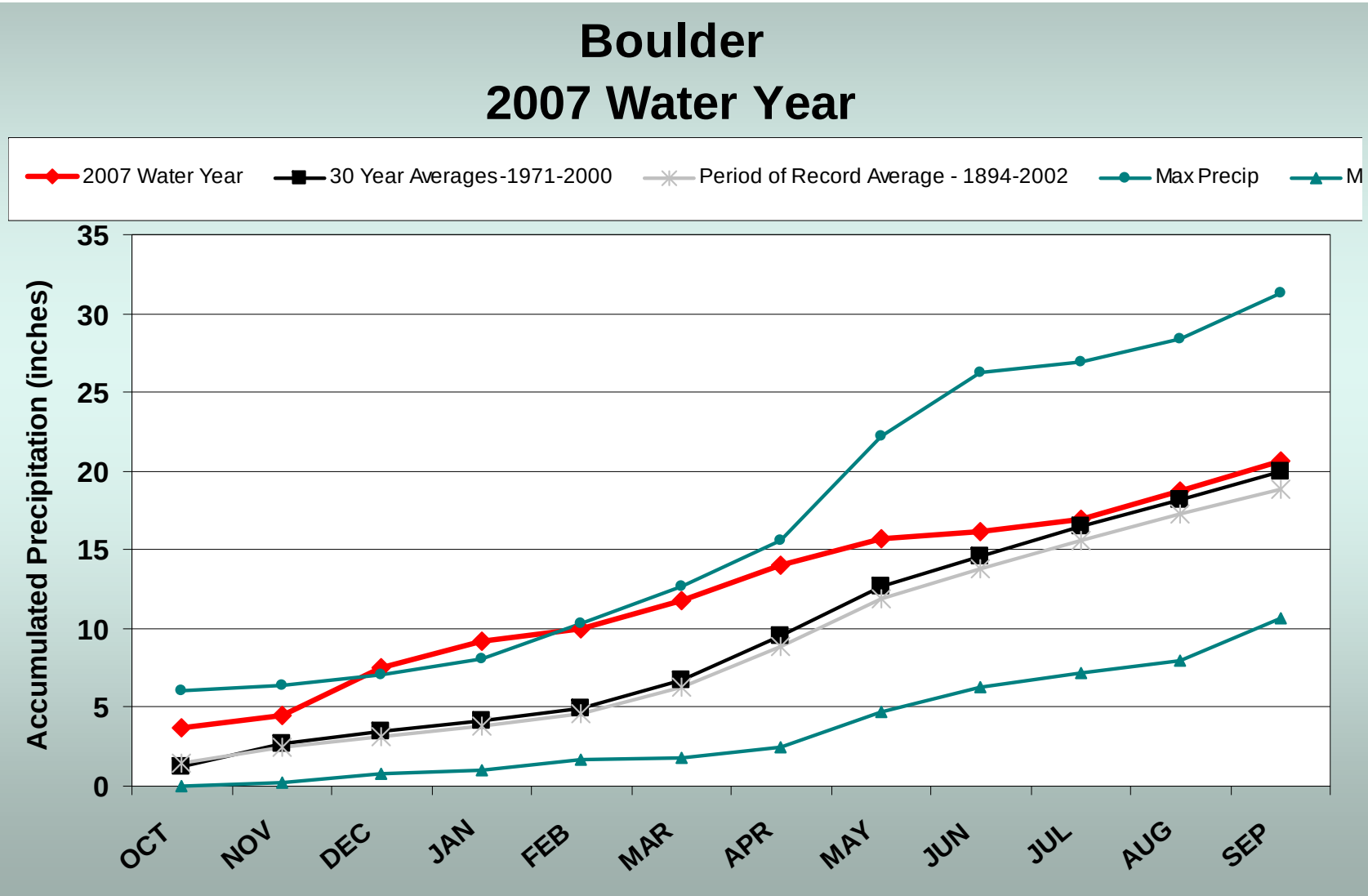
CoCoRaHS September 1-25, 2007 precipitation by County



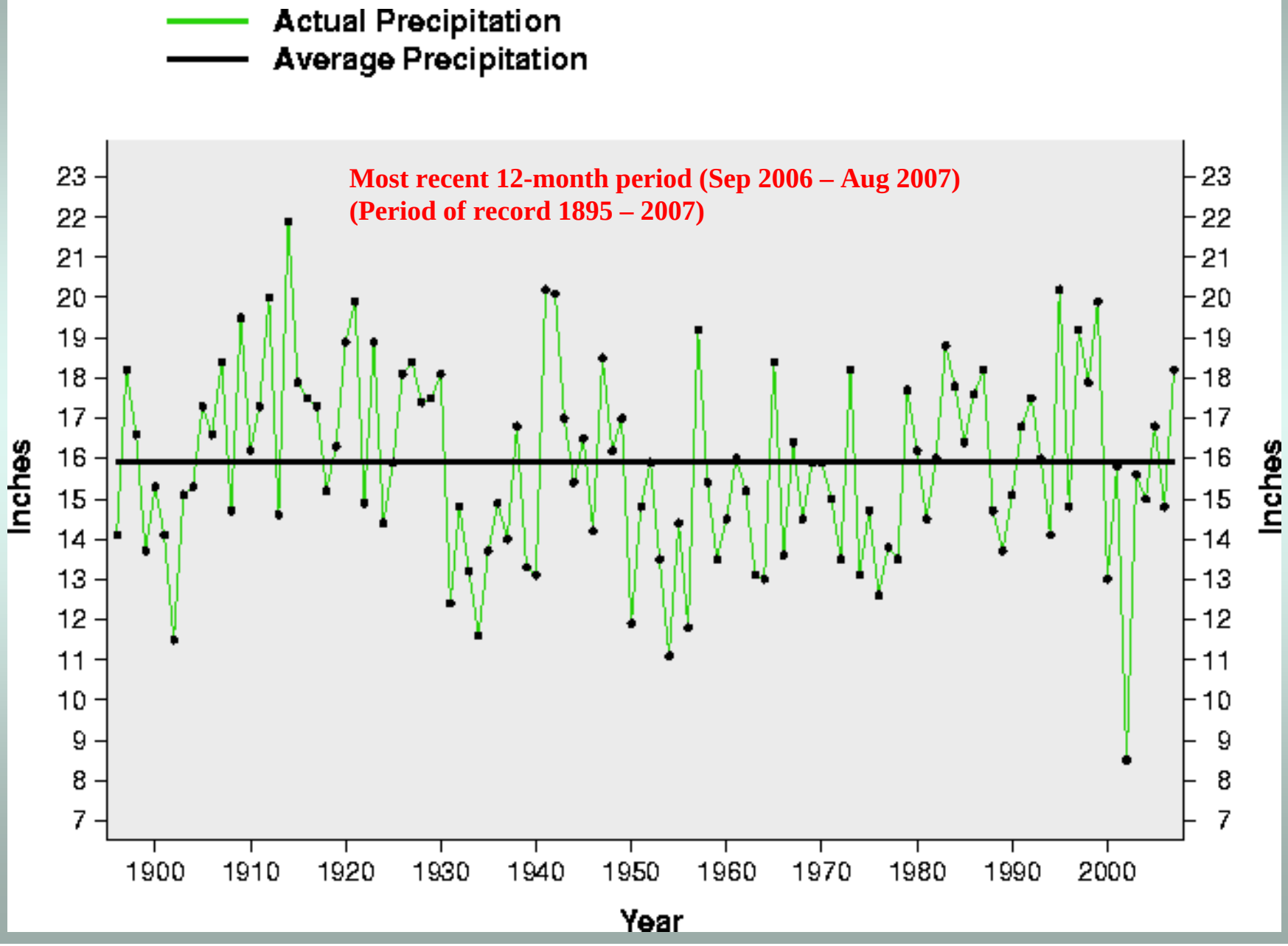
Water Year 2007 (through August 2007) precipitation as a percent of average (Prism)



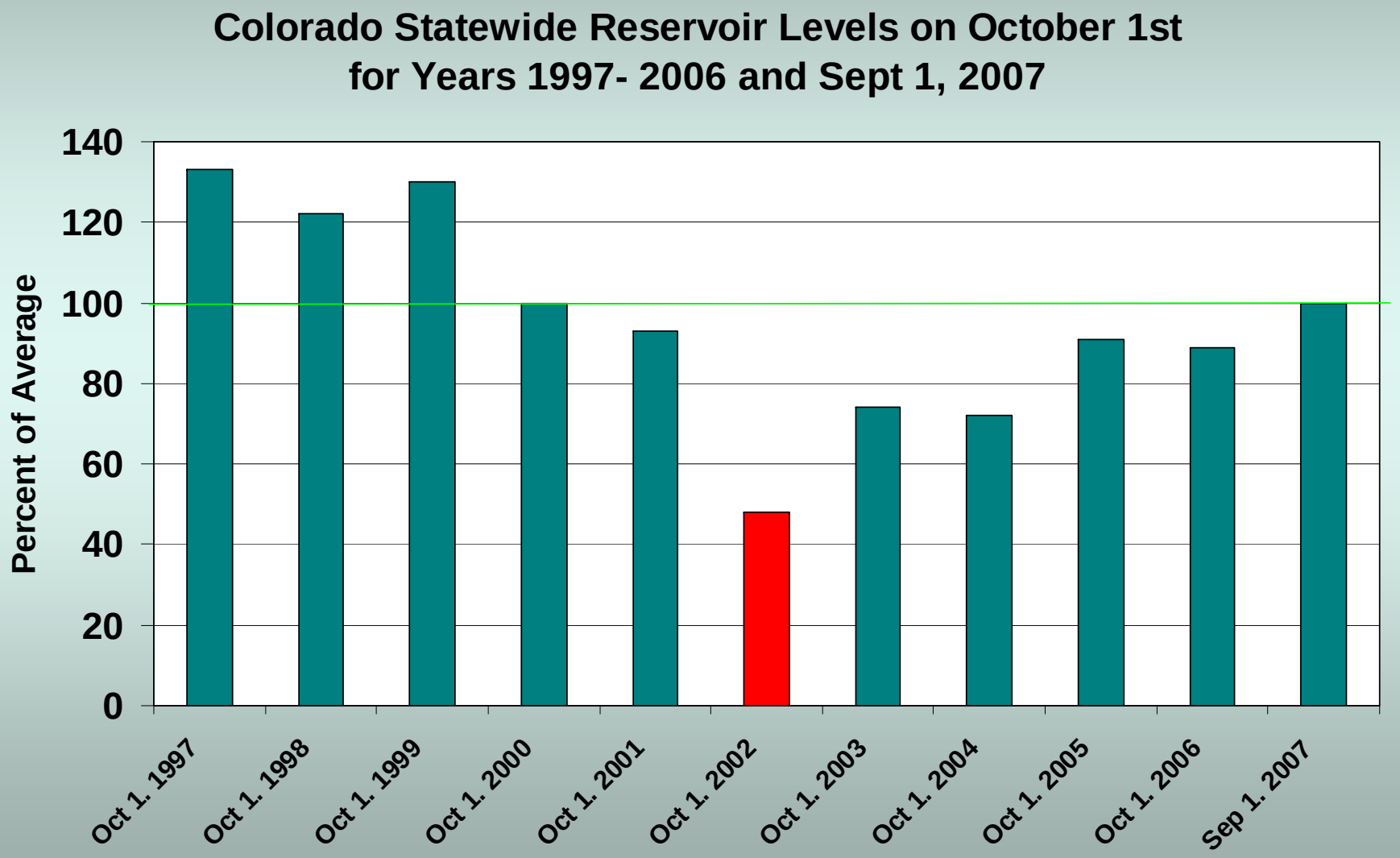
Boulder Water Year 2007



Colorado Precipitation in Historic Perspective

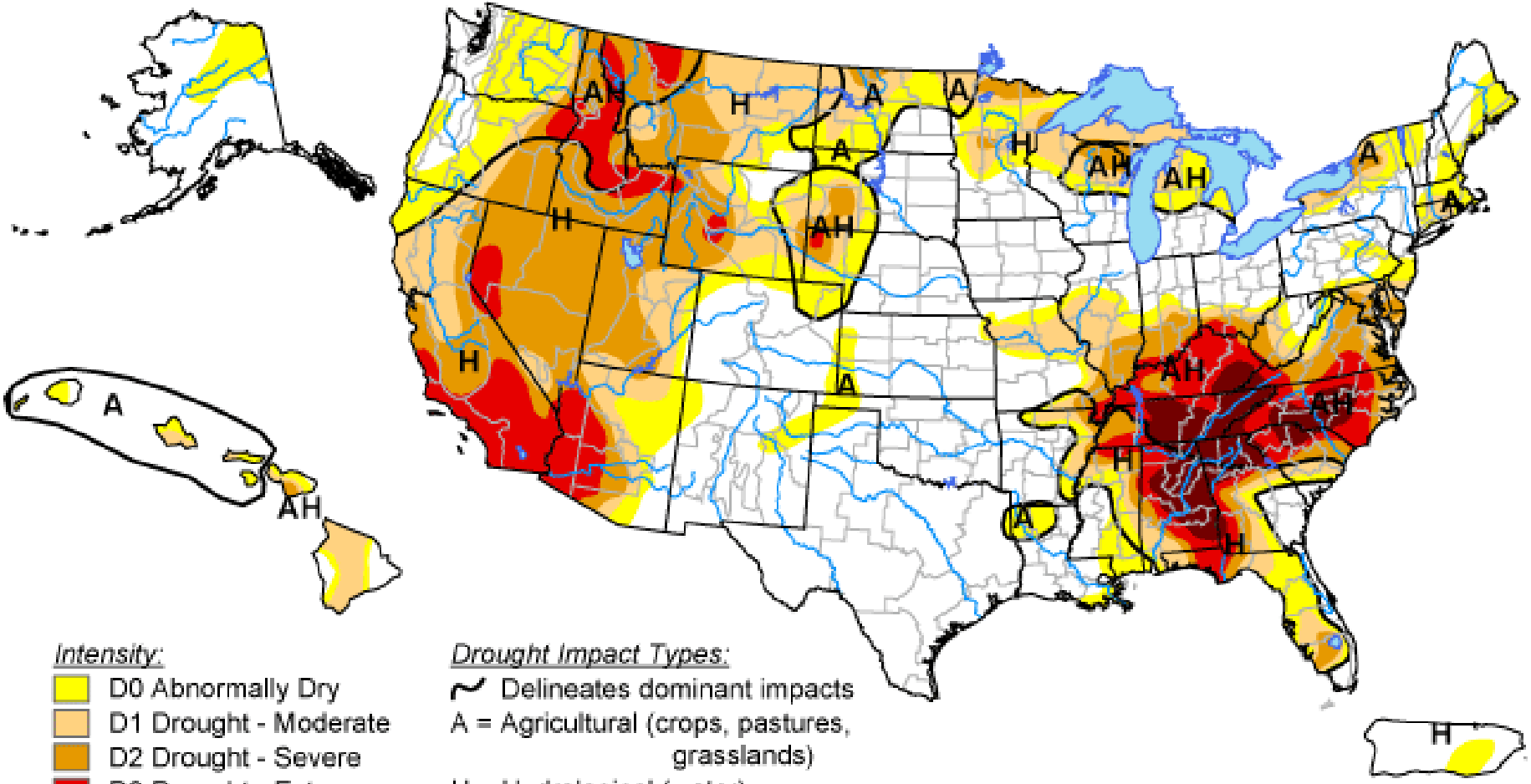


Reservoir Storage Levels



U.S. Drought Monitor

October 2, 2007
Valid 8 a.m. EDT



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

Drought Impact Types:
- ~ Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

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

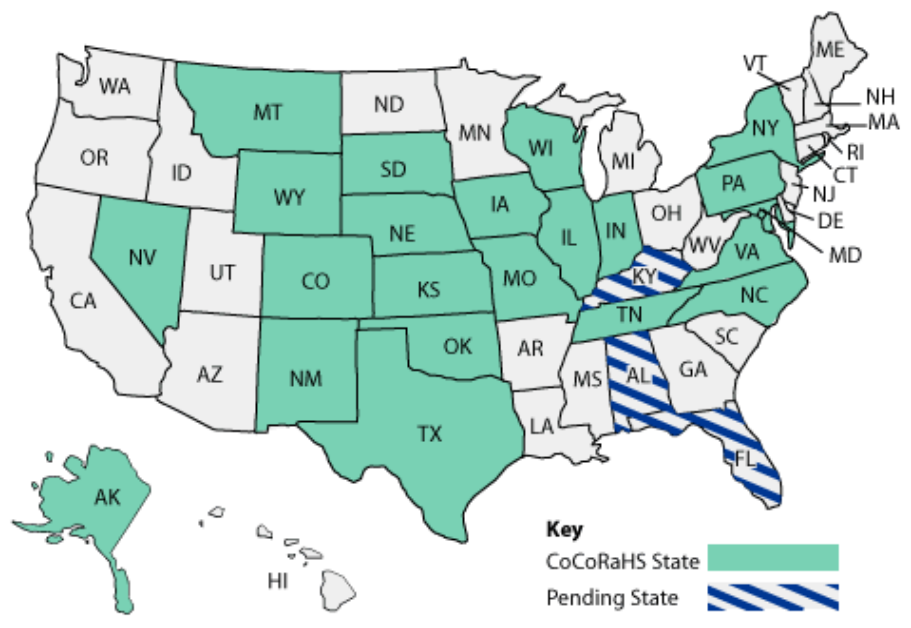
http://drought.unl.edu/dm

Released Thursday, October 4, 2007

Author: Jay Lawrimore/Liz Love-Brotak, NOAA/NESDIS/NCDC

And How About CoCoRaHS?

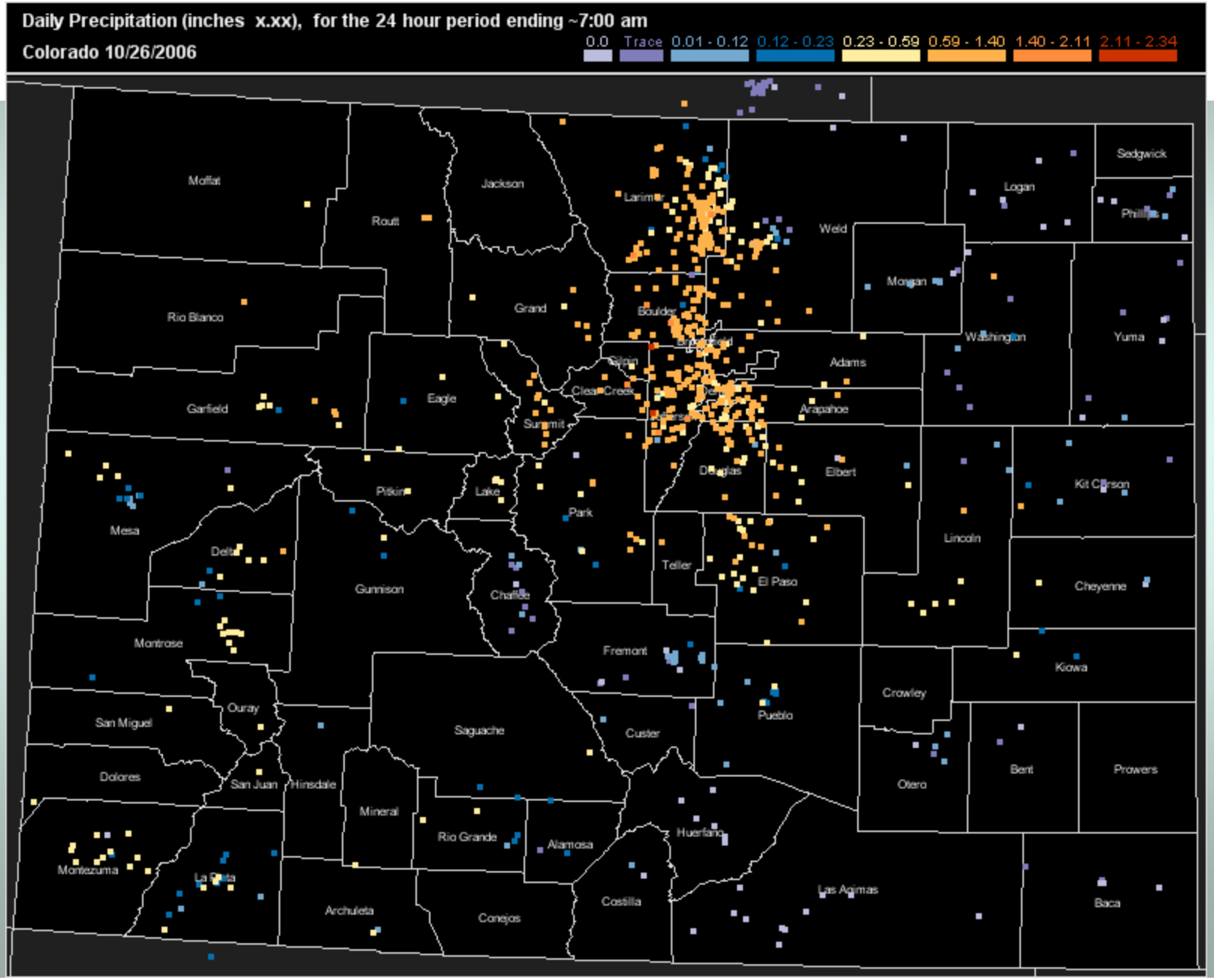
- Hundreds of new observers, especially from other states
- Added 10 new states to the program since we last met



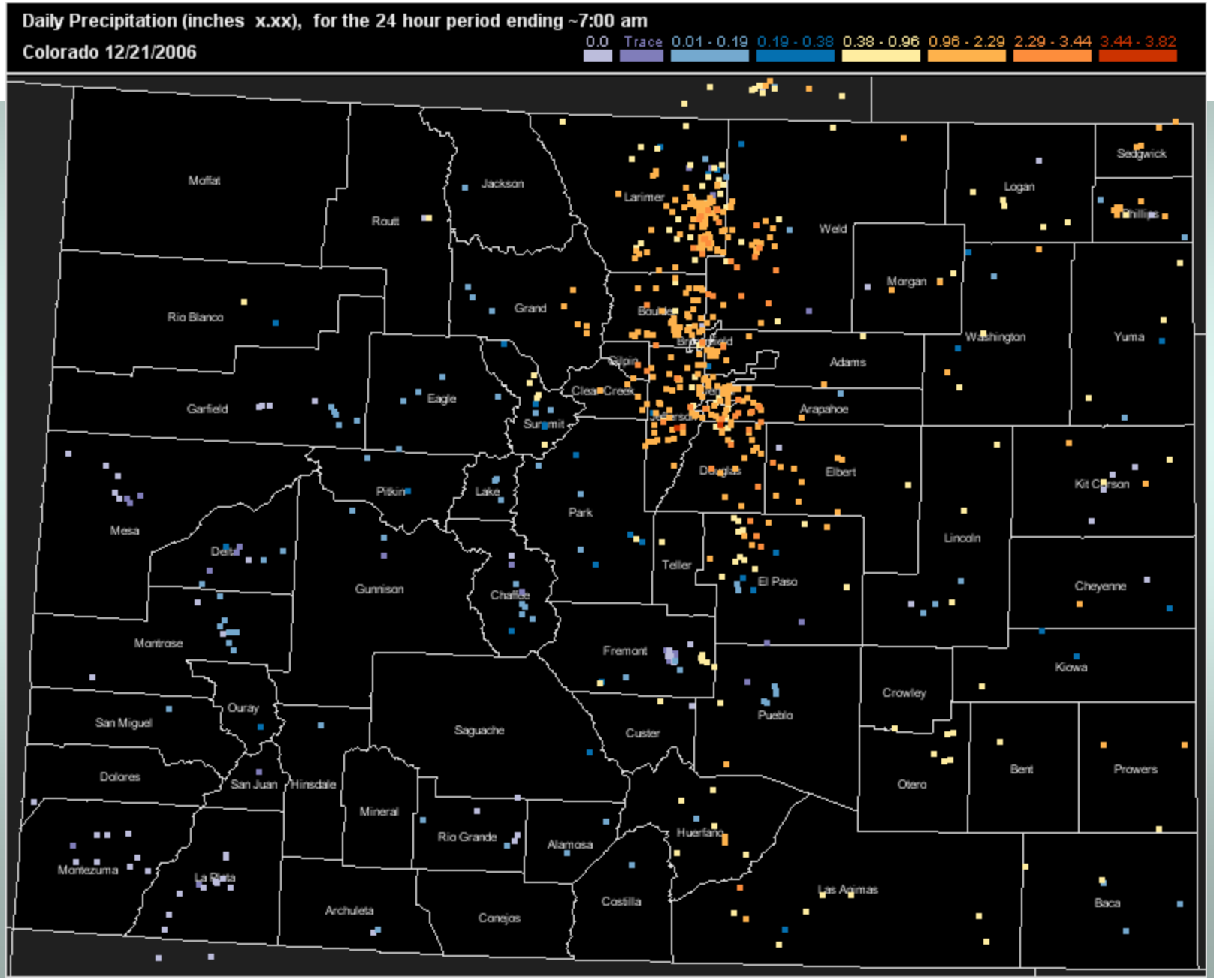
CoCoRaHS

Community Collaborative Rain, Hail, & Snow Network

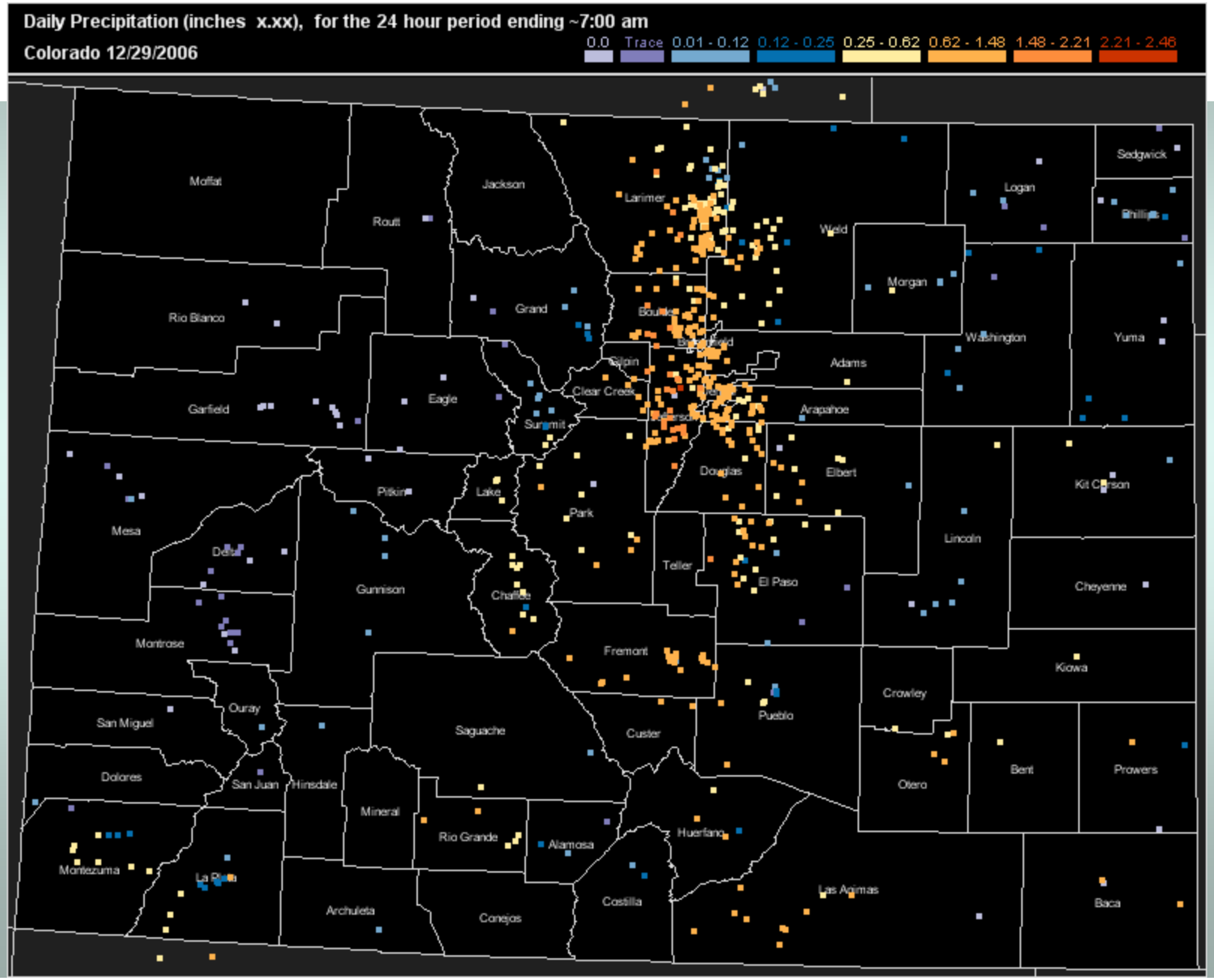
CoCoRaHS Precipitation map for Oct 26, 2006



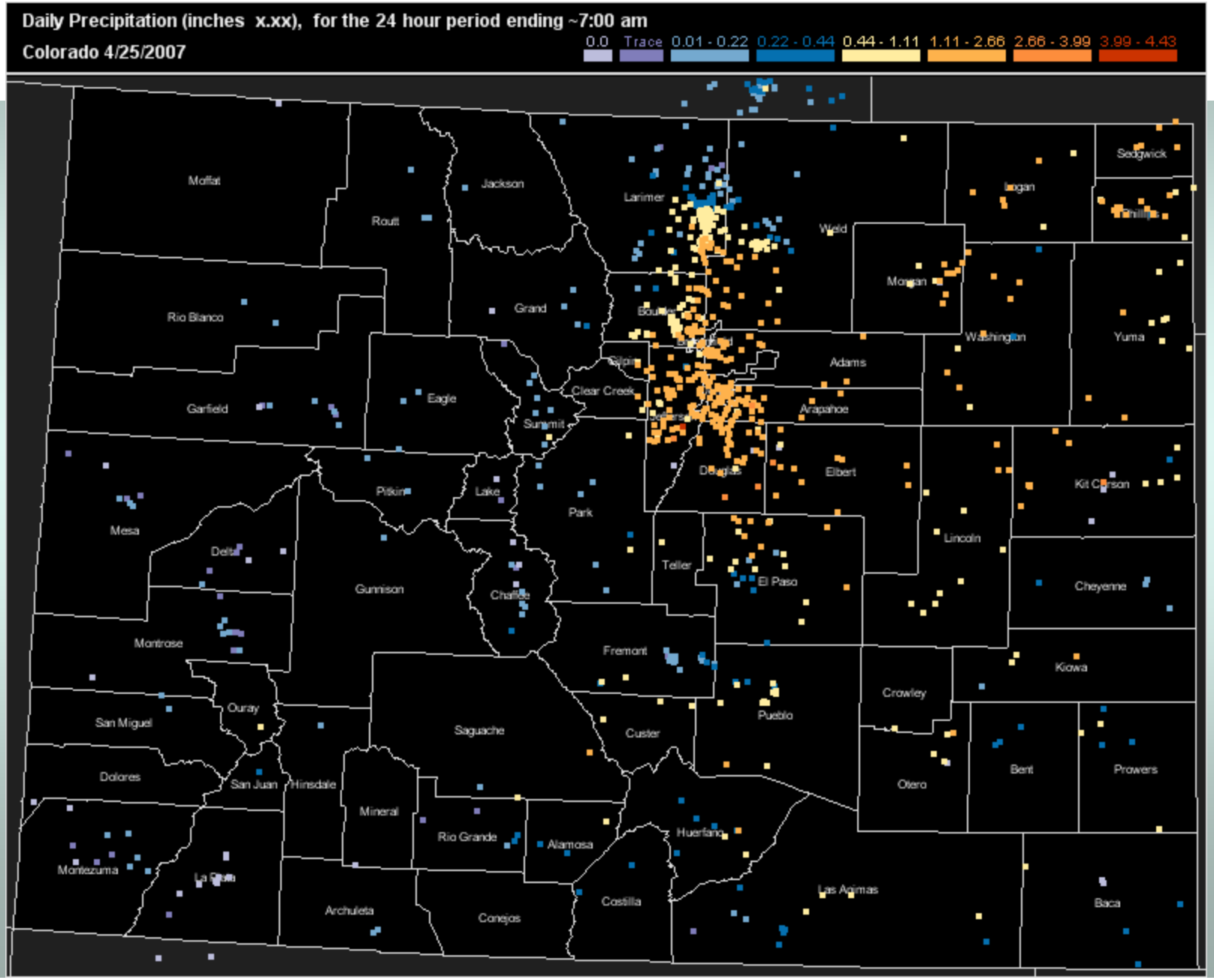
CoCoRaH Precipitation map for Dec 21, 2006



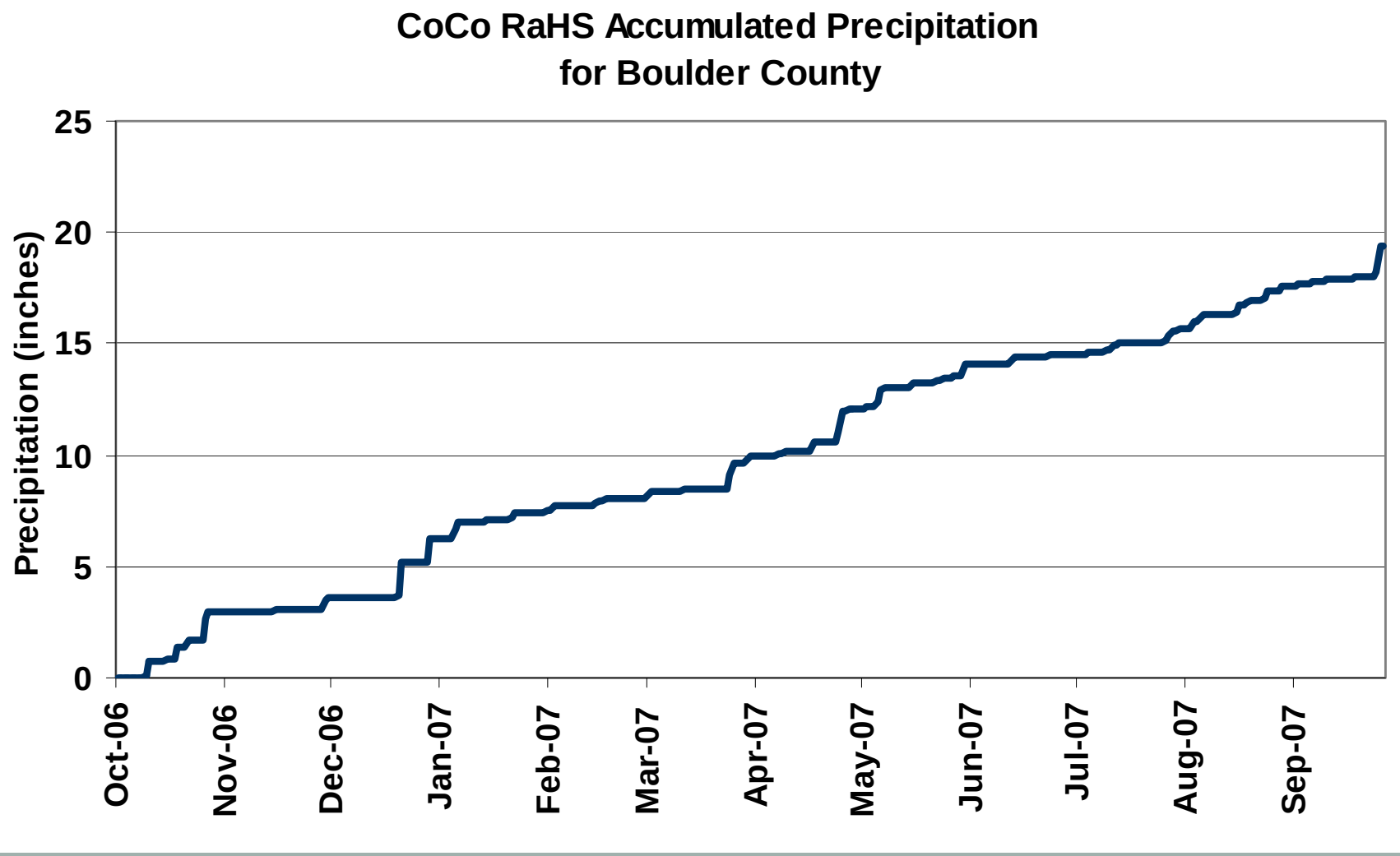
CoCoRaH Precipitation map for Dec 29, 2006



CoCoRaHS Precipitation map for April 25, 2007



Boulder County CoCoRaHS Accumulation for Water Year 2007



For More Information, 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.

Is Colorado Getting Warmer?

Nolan Doesken

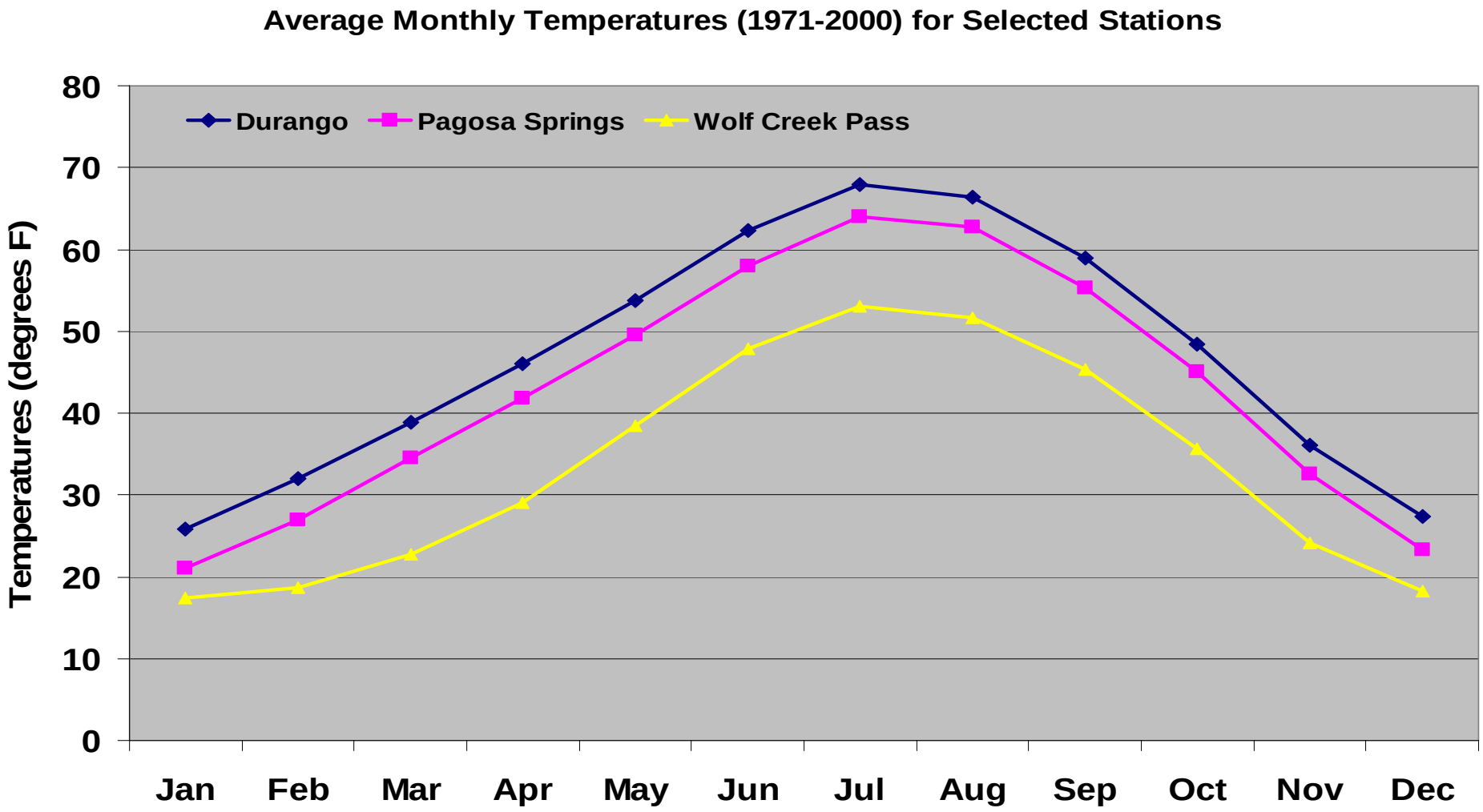
State Climatologist, Colorado Climate Center
Atmospheric Science Department
Colorado State University

Presented at *Colorado Climate and Weather Seminar, 21 September 2007, Longmont, CO*

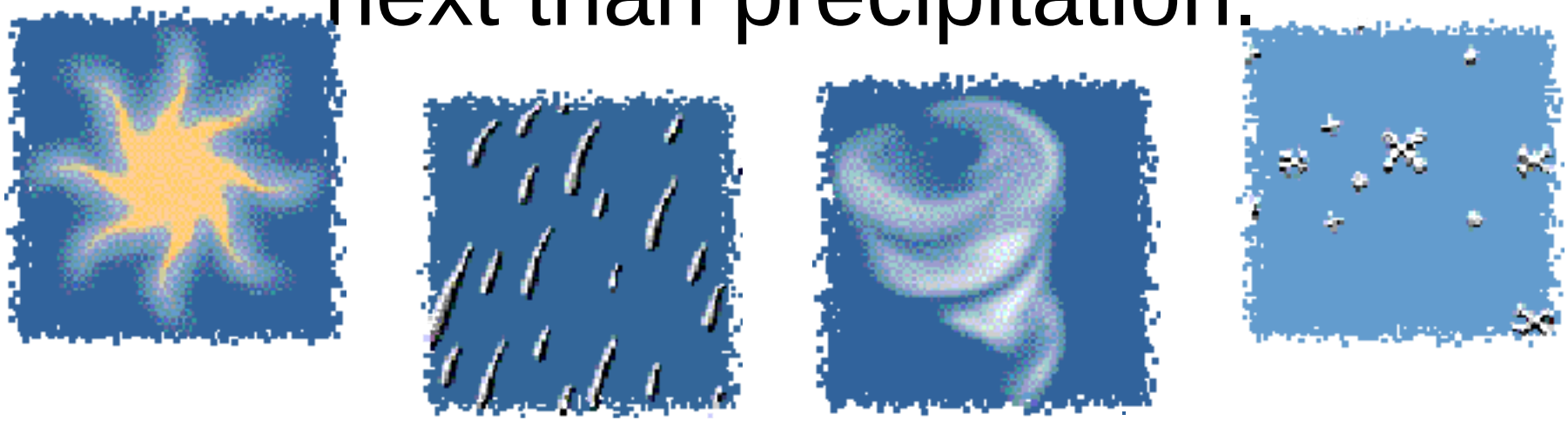
Prepared by Odie Bliss

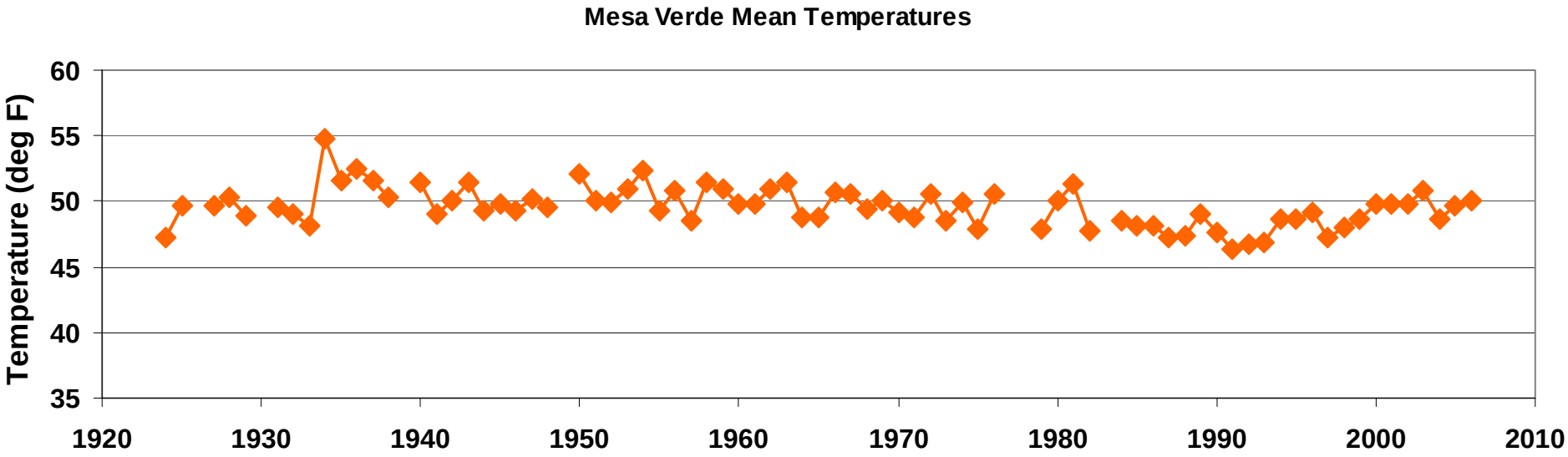

What have we learned from nearly 120 years of continuous climate monitoring?

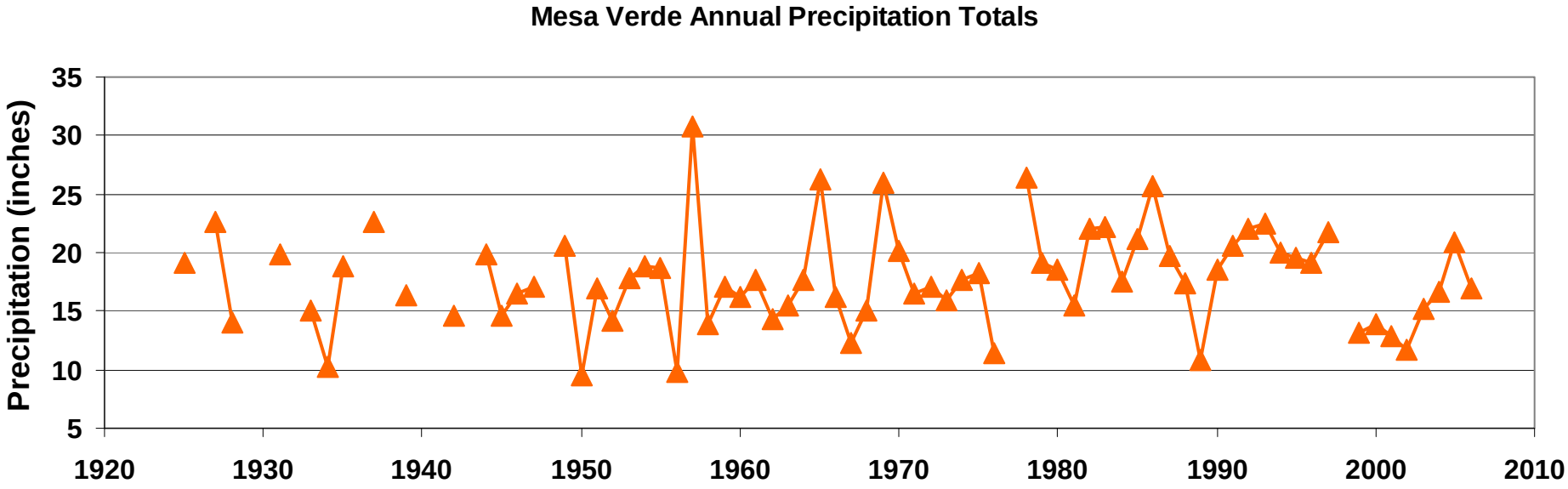
Winters are consistently colder than summers – ☺



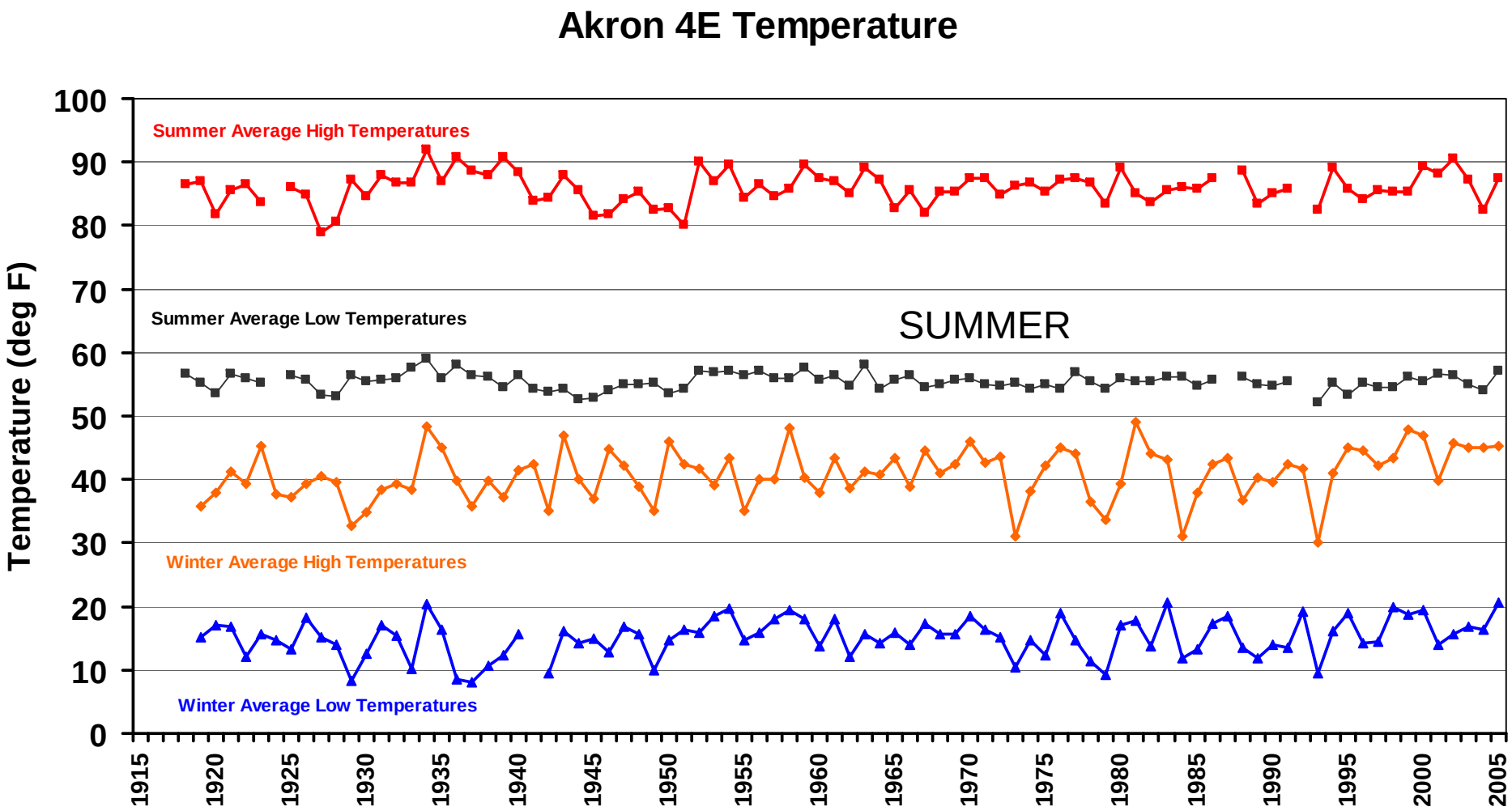
Temperatures are far more stable than precipitation. In fact most other climatic elements (humidity, wind, sunshine and cloudiness, evaporation, etc.) are much more consistent from one year to the next than precipitation.



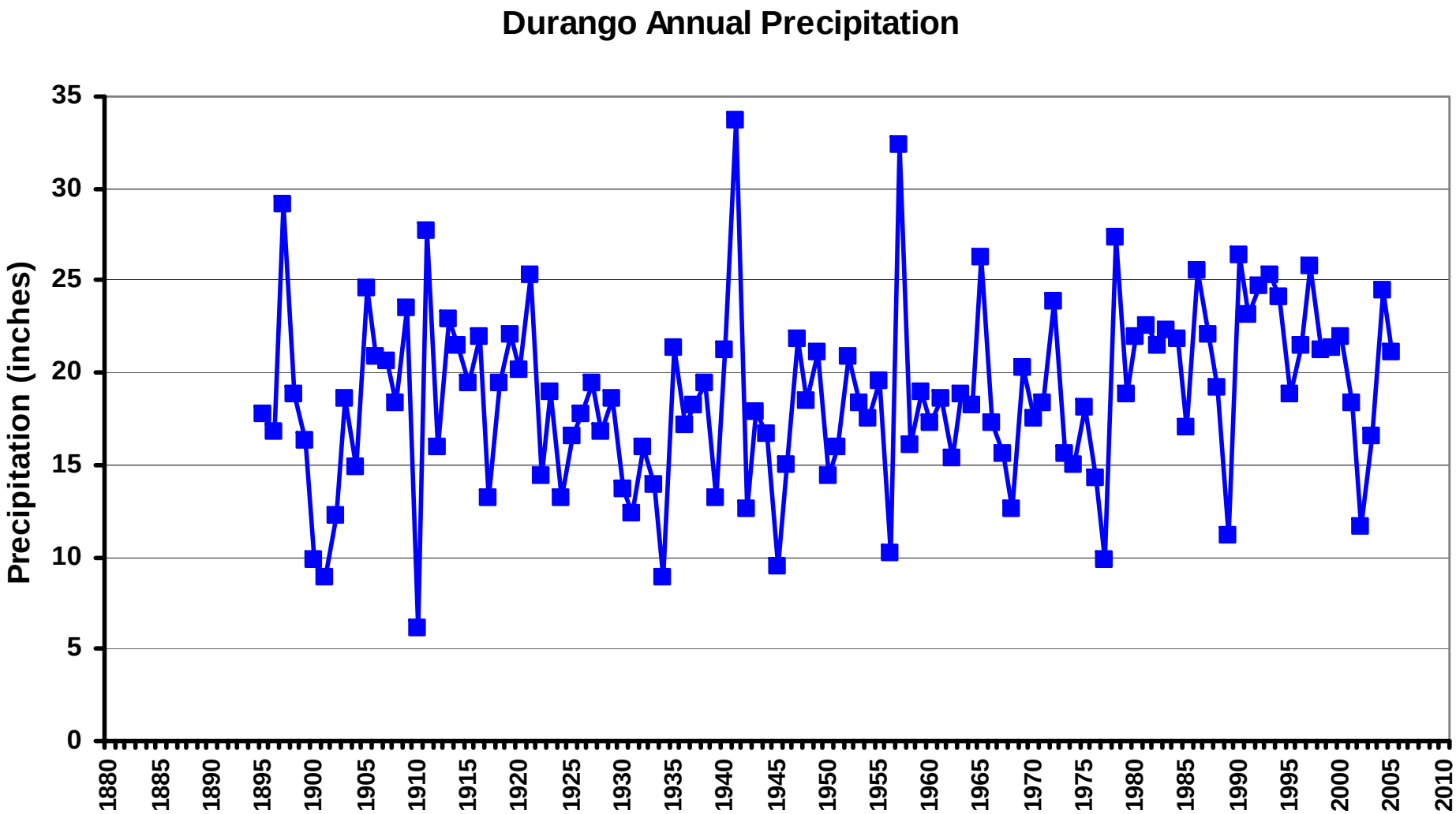

Mesa Verde Mean Temperatures
Temperature (deg F)
60
55
50
45
40
35
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010


Mesa Verde Annual Precipitation Totals
Precipitation (inches)
35
30
25
20
15
10
5
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

Some seasons are more consistent than others – nighttime summer temperatures are most stable



Precipitation varies by as much as 400% from a very dry year to a very wet year

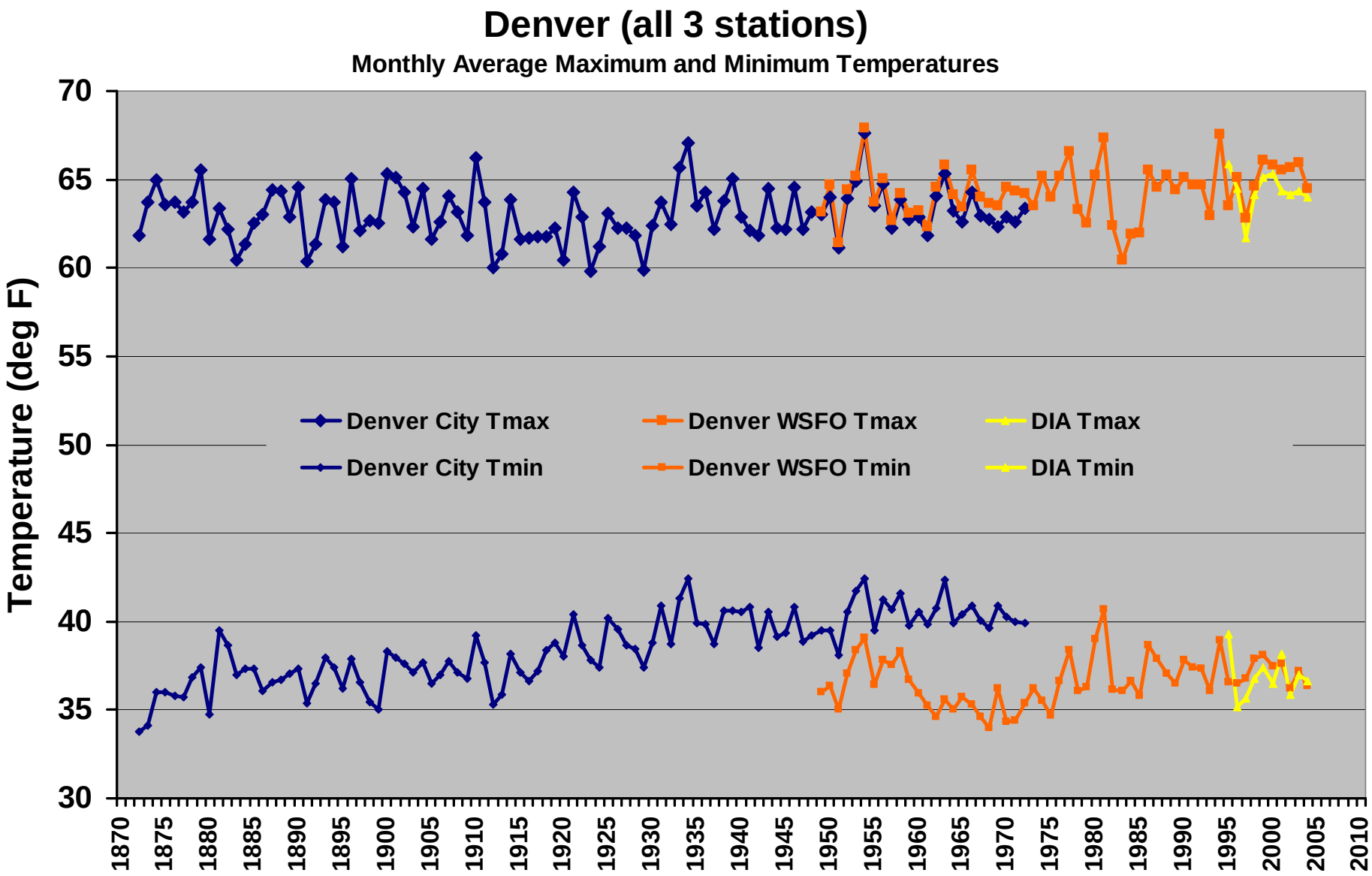


Confidently detecting climatic trends is much more challenging and difficult than determining spatial patterns, seasonal cycles, or year-to-year variations

We can find many frustrating limitations to our climate records:

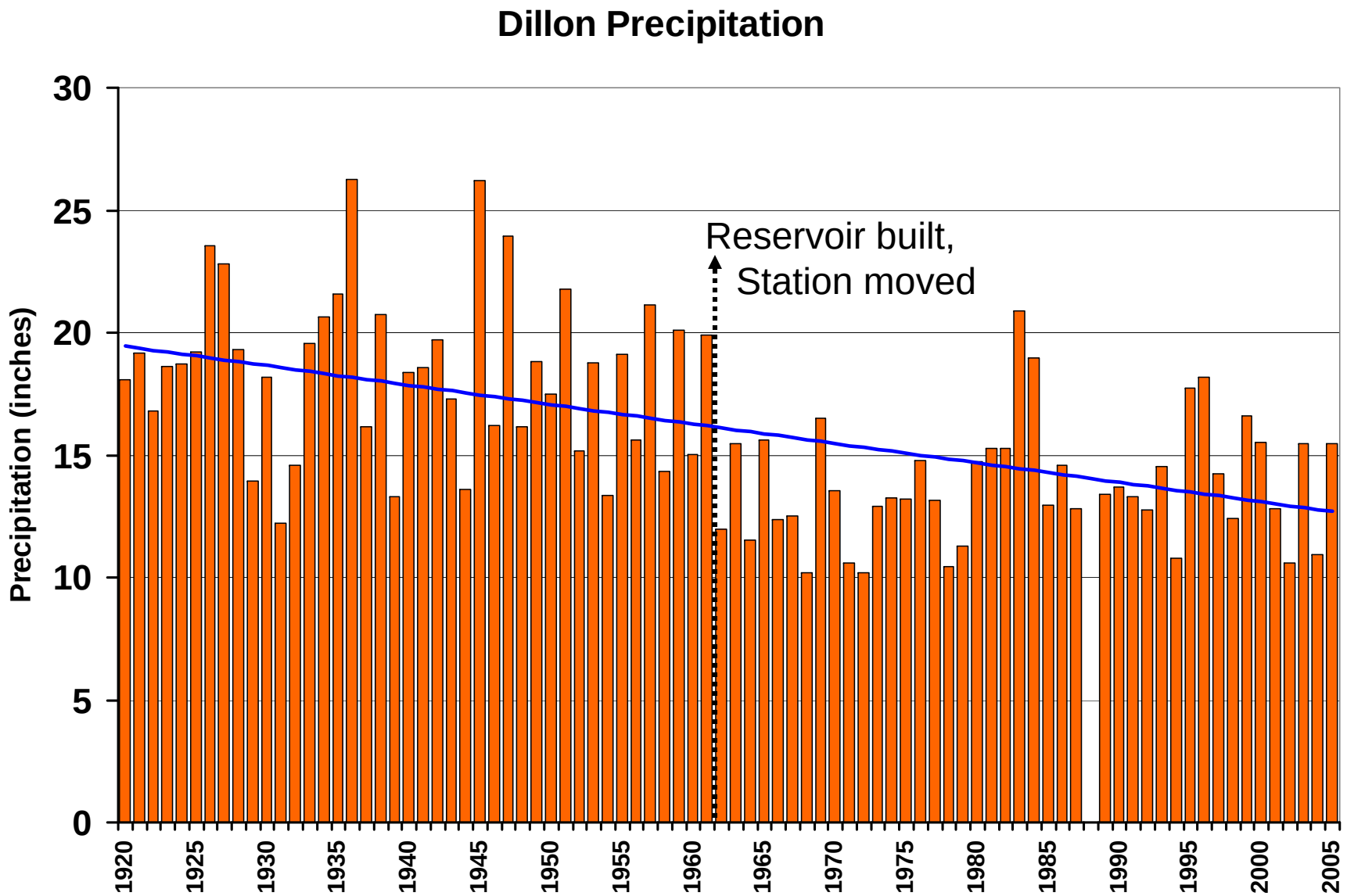
- Changing instrumentation
- Aging weather observers
- Changing environments around our weather stations
- Changing weather station locations
- Automation, etc.

Denver All Stations

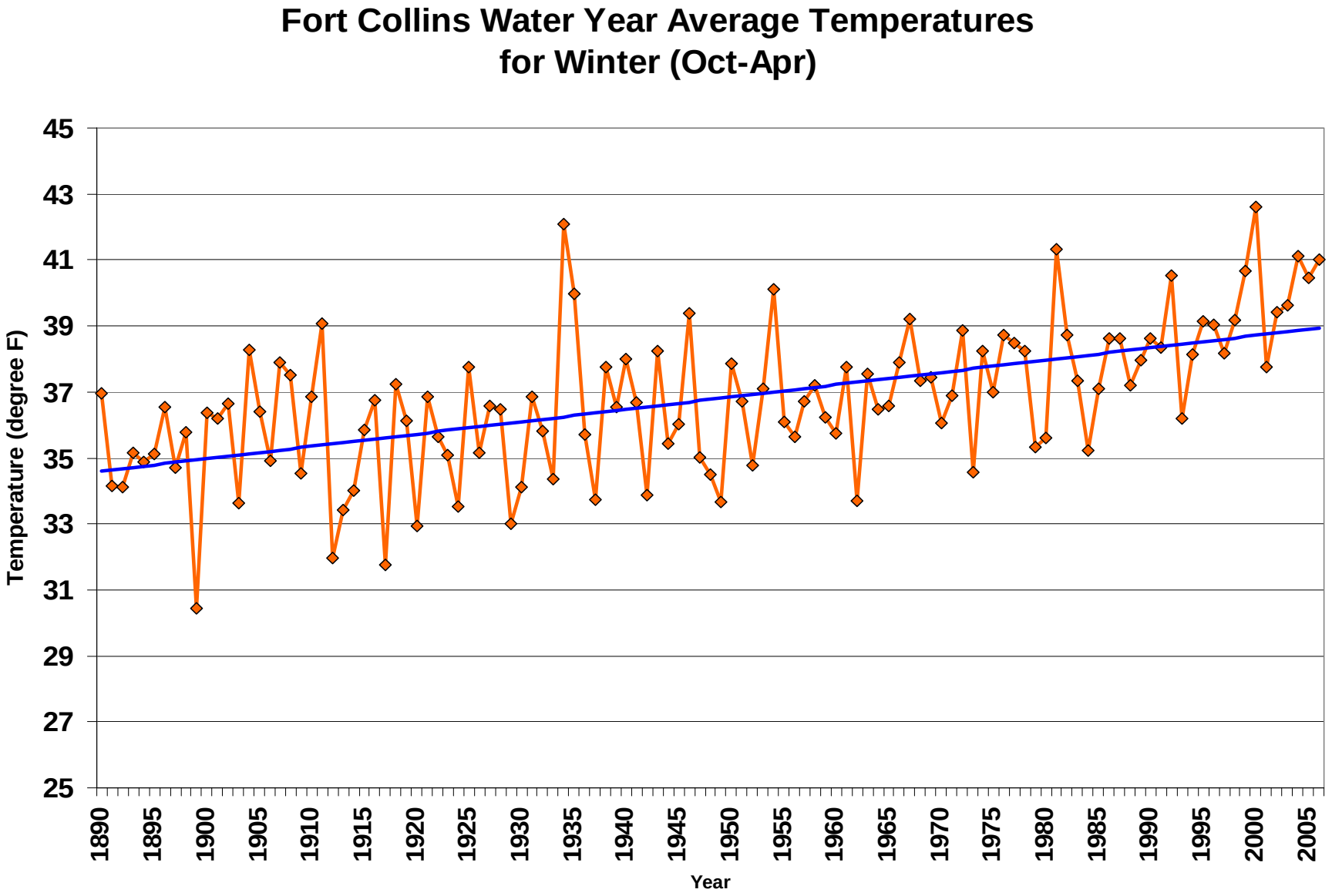


Changing stations disrupt long-term record

Dillon Annual Precipitation



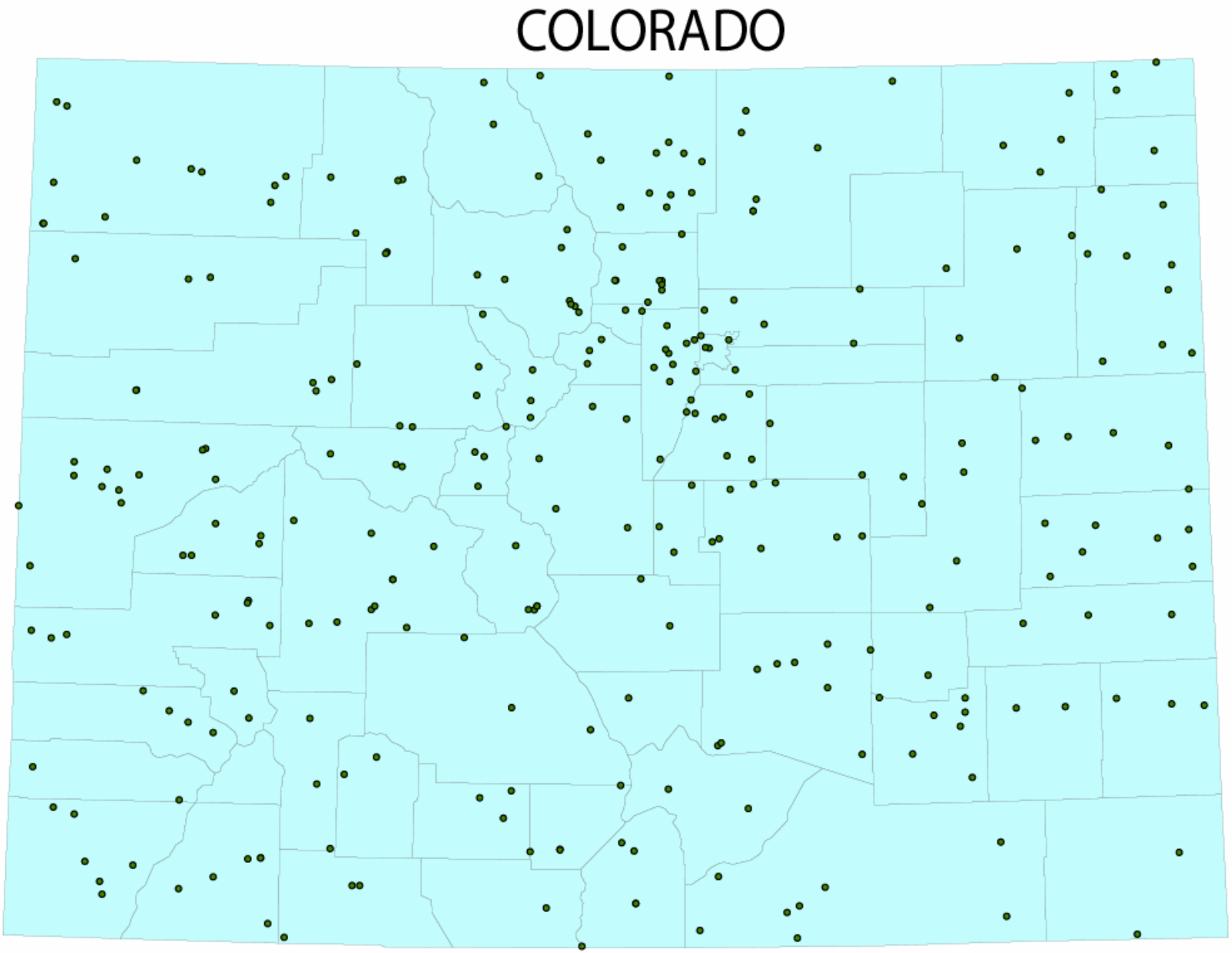
Fort Collins Winter Temperatures



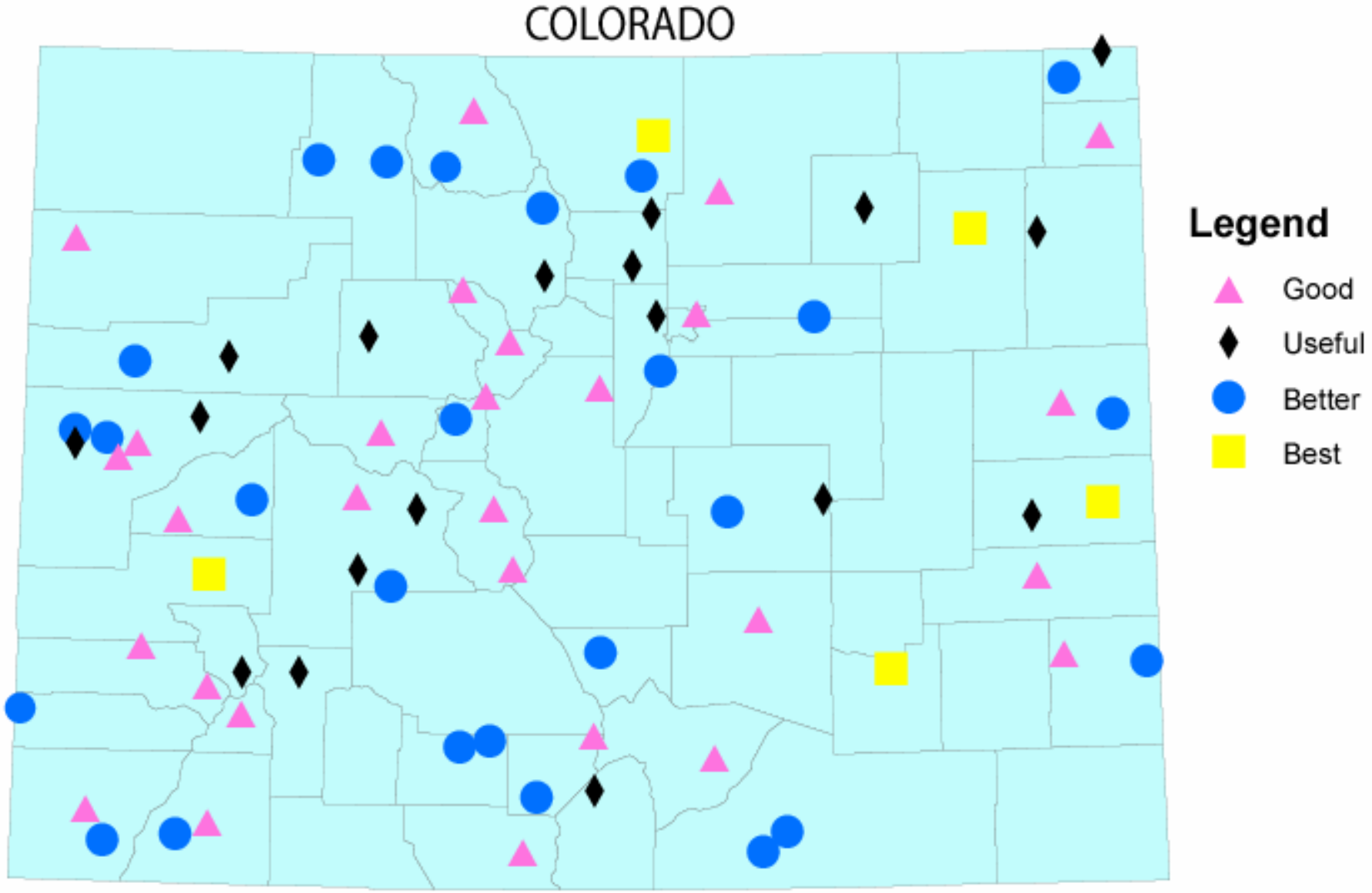
Urbanization leads to warming

Poor station location can also lead to warming

Of All Our Climate Observing Stations

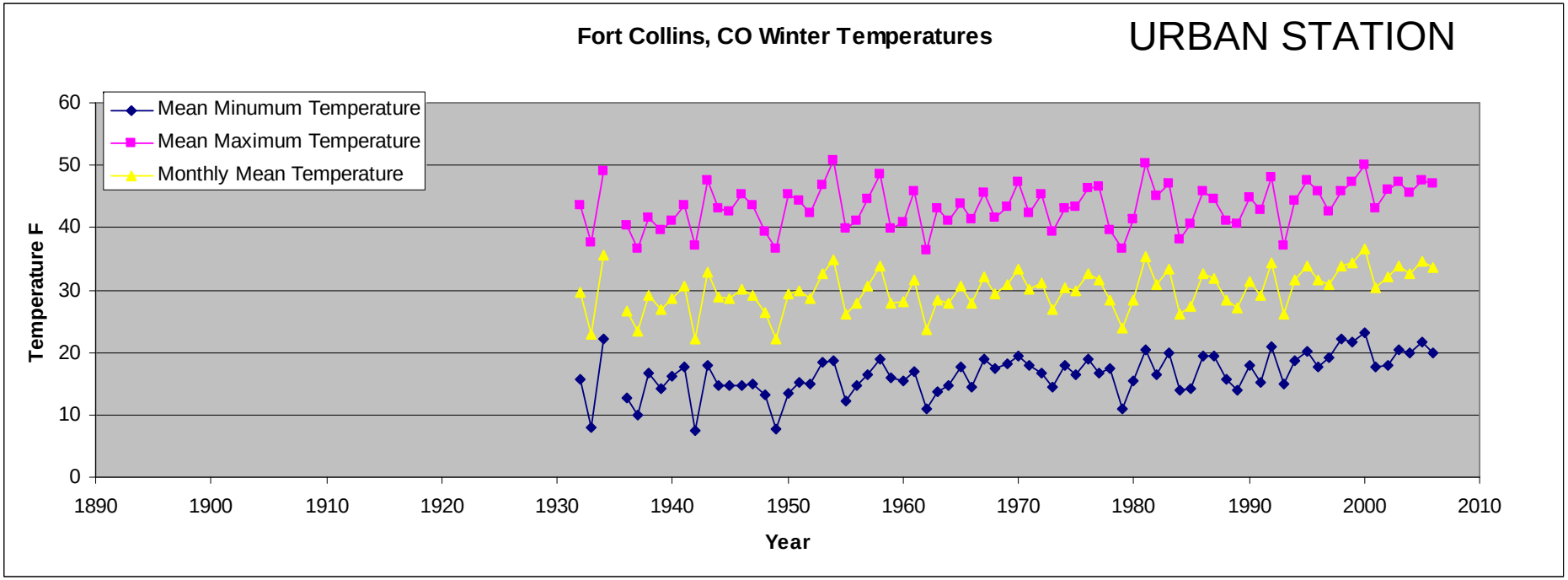


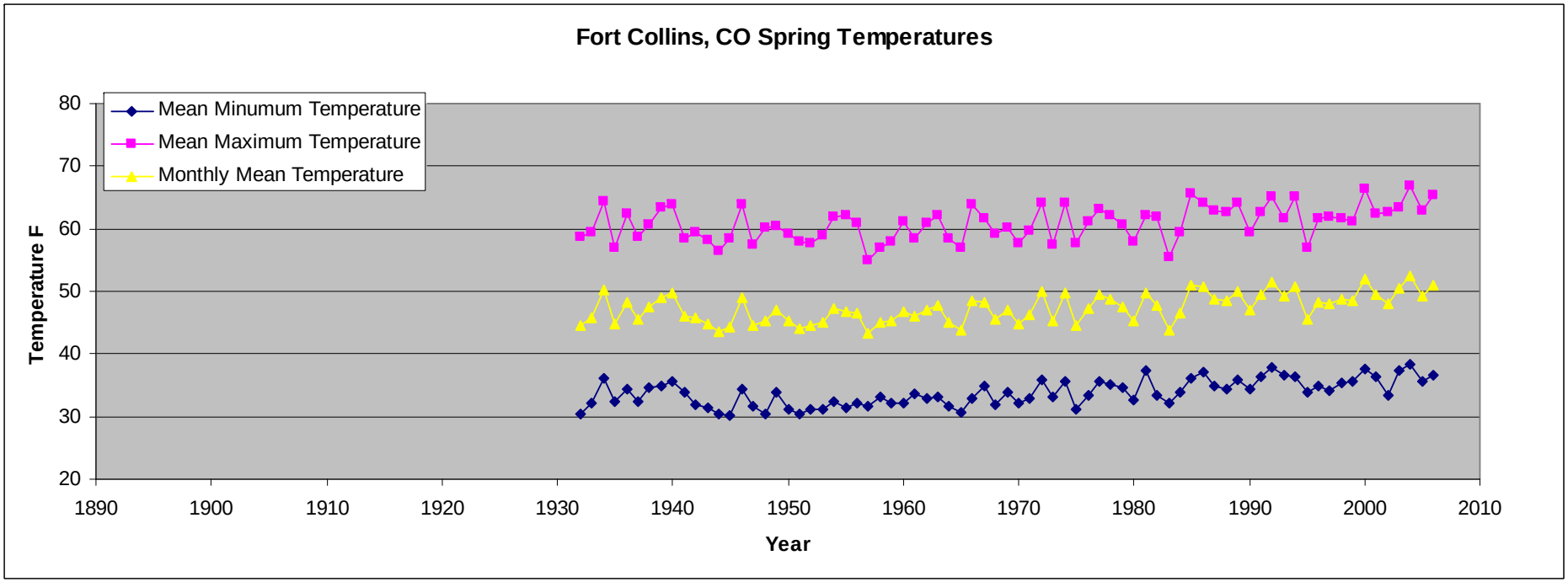
Only a Few Have Excellent Long-Term Records

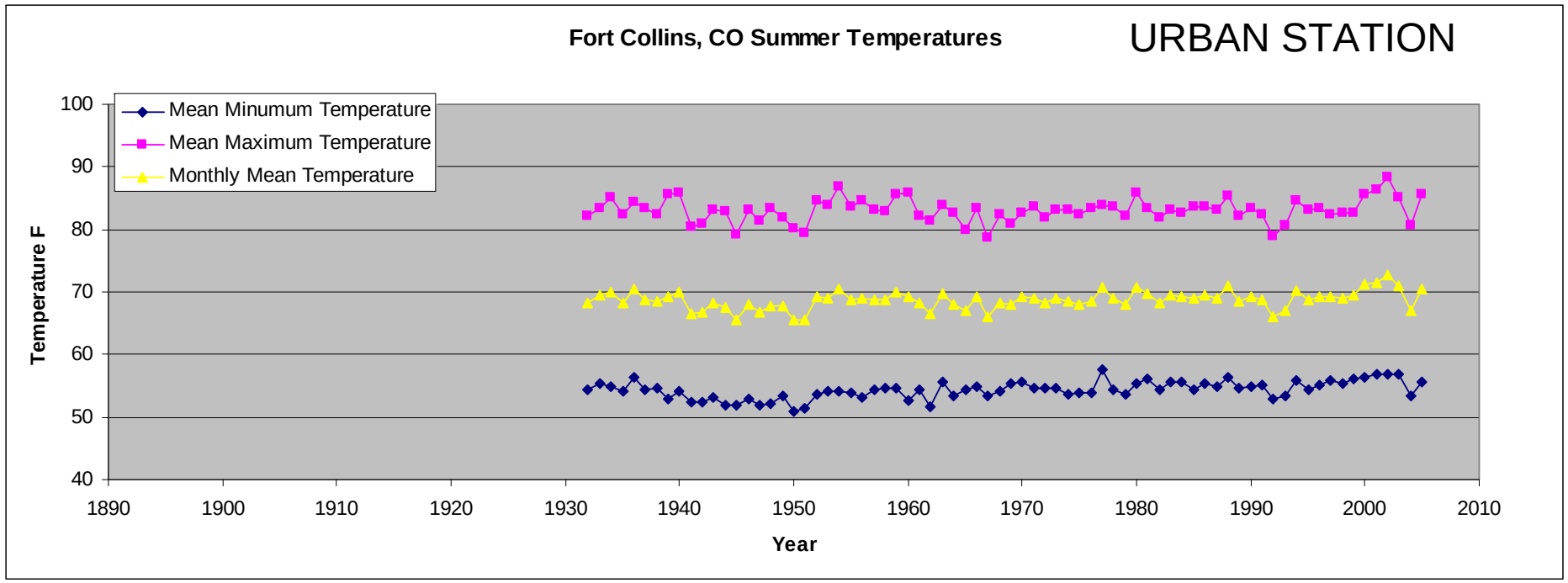


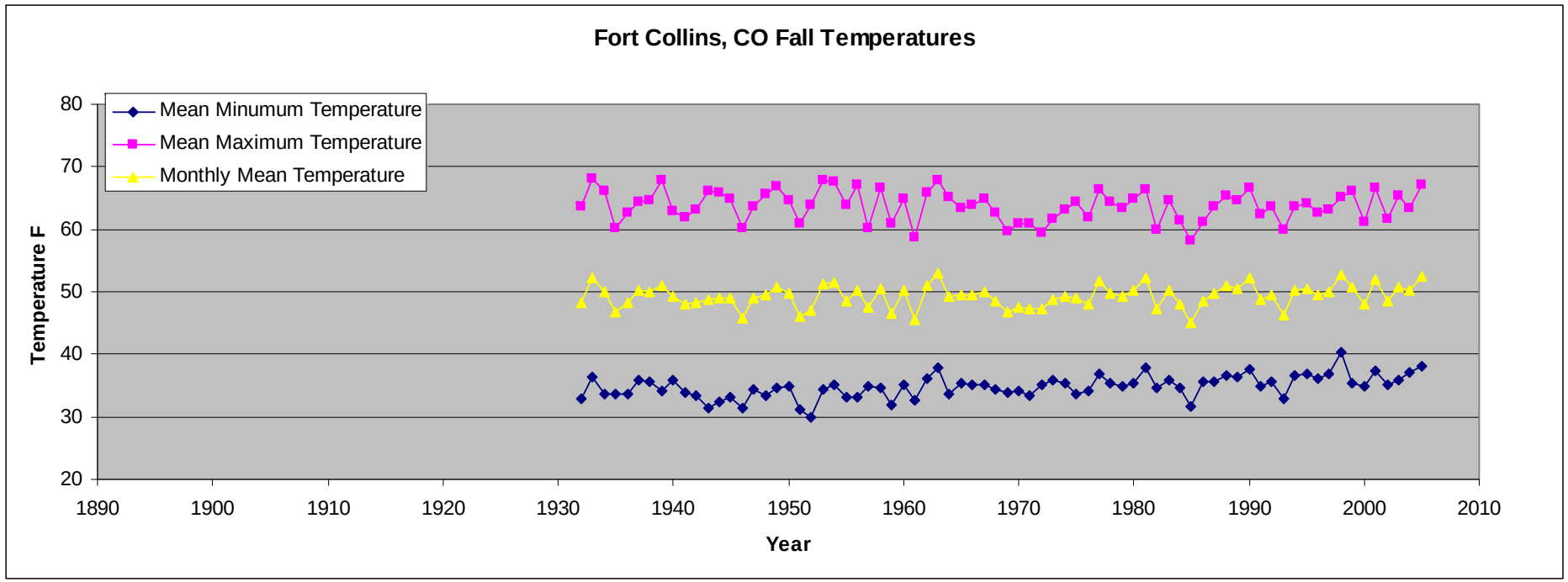
Still, our climate records are more complete, consistent, and widespread than nearly all other forms of long-term environmental monitoring (i.e. we shouldn’t whine).

Let’s Look at Long-Term Temperature


Fort Collins, CO Winter Temperatures
URBAN STATION
Mean Minumum Temperature
Mean Maximum Temperature
Monthly Mean Temperature
Temperature F
60
50
40
30
20
10
0
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year

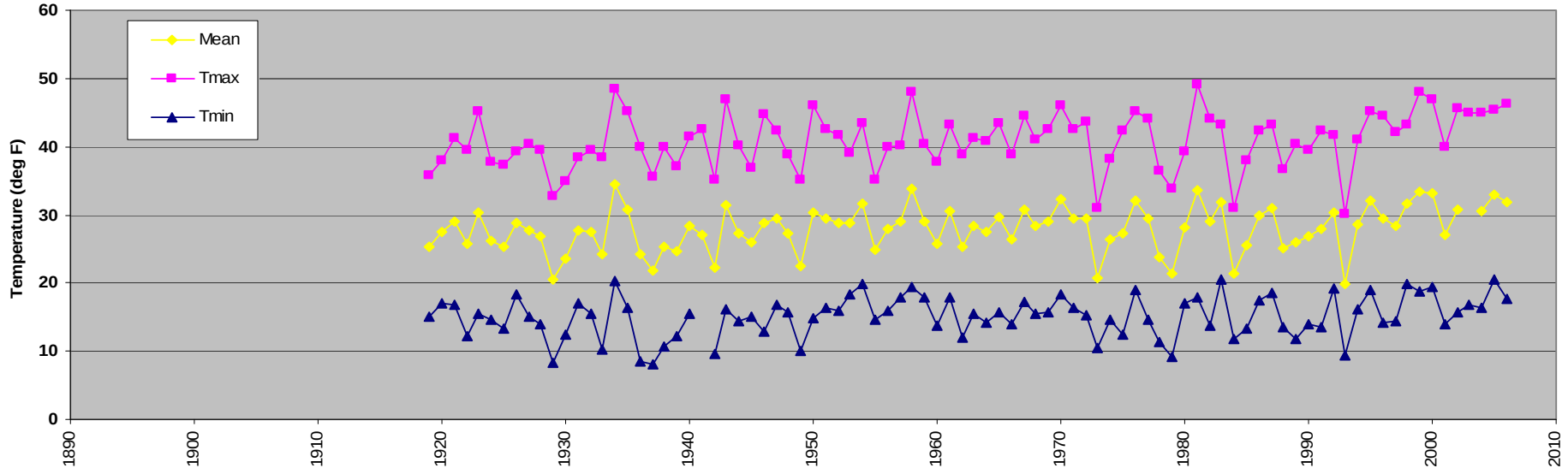

Fort Collins, CO Spring Temperatures
Mean Minumum Temperature
Mean Maximum Temperature
Monthly Mean Temperature
Temperature F
80
70
60
50
40
30
20
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year


Fort Collins, CO Summer Temperatures
URBAN STATION
Mean Minumum Temperature
Mean Maximum Temperature
Monthly Mean Temperature
Temperature F
100
90
80
70
60
50
40
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year

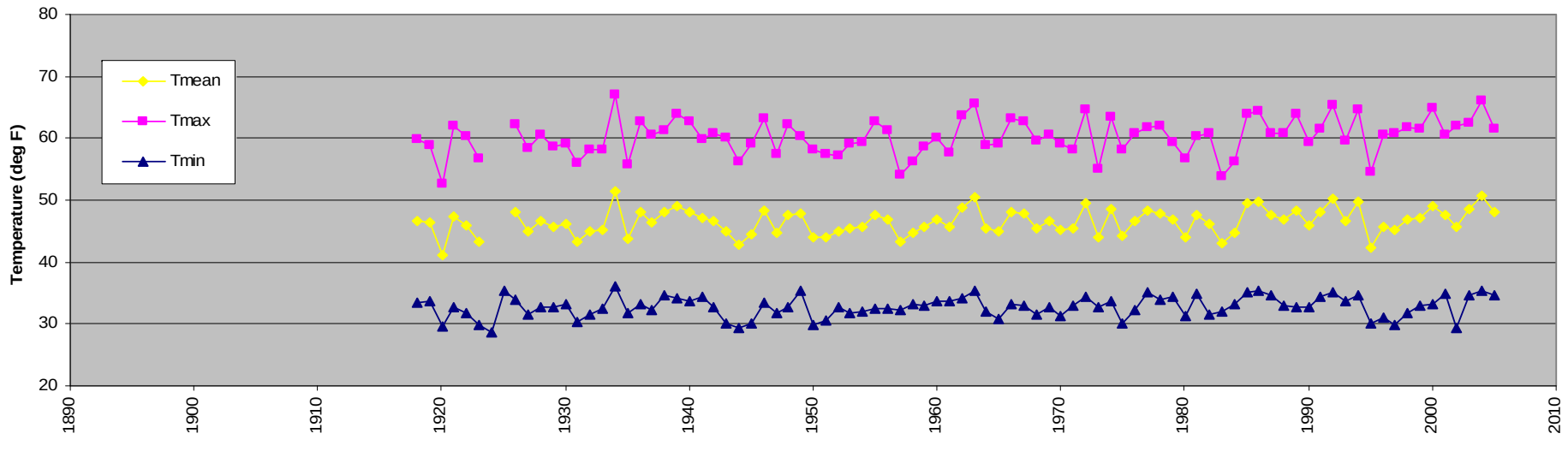

Fort Collins, CO Fall Temperatures
Mean Minumum Temperature
Mean Maximum Temperature
Monthly Mean Temperature
Temperature F
80
70
60
50
40
30
20
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Year

Akron 4E Winter (DJF) Temperatures

RURAL STATION

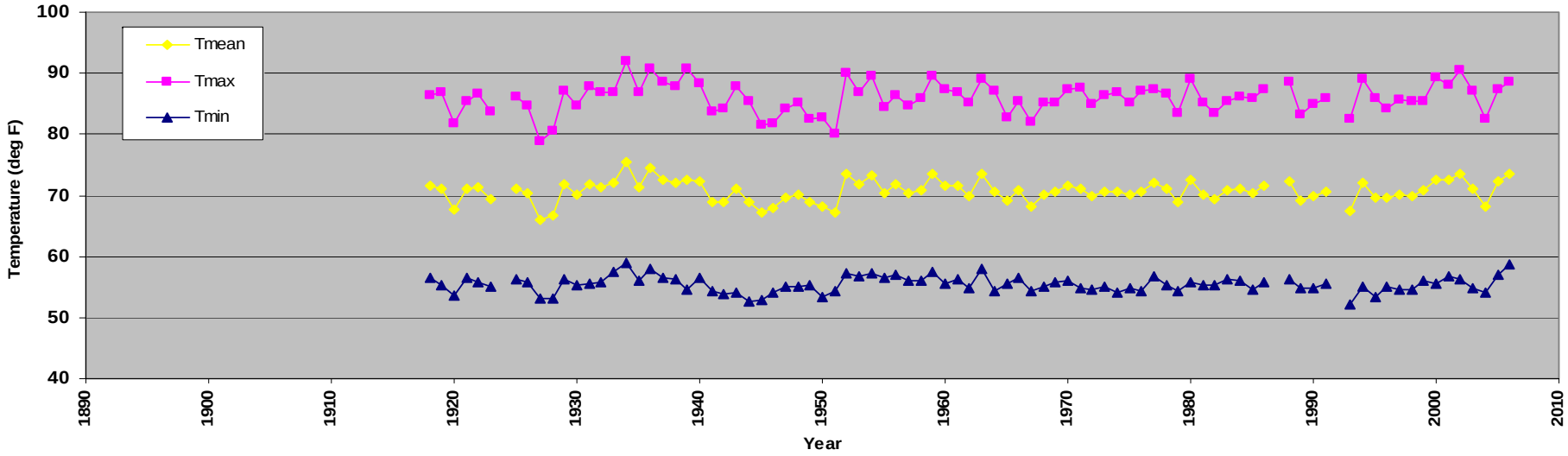


Akron 4E Spring (MAM) Temperatures

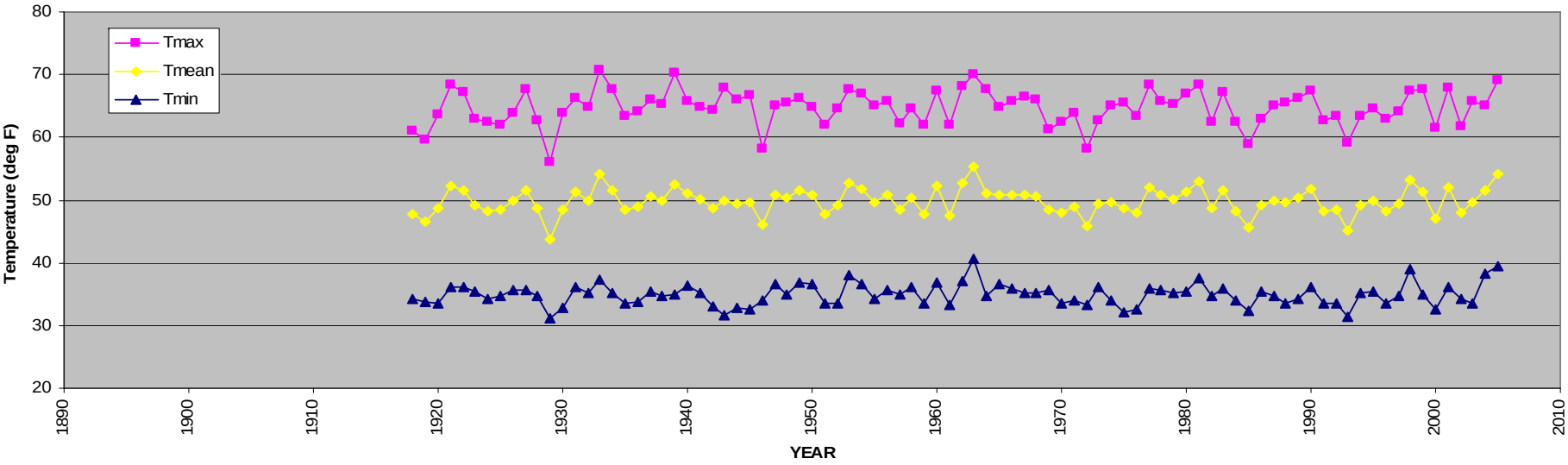


Akron 4E Summer (JJA) Temperatures

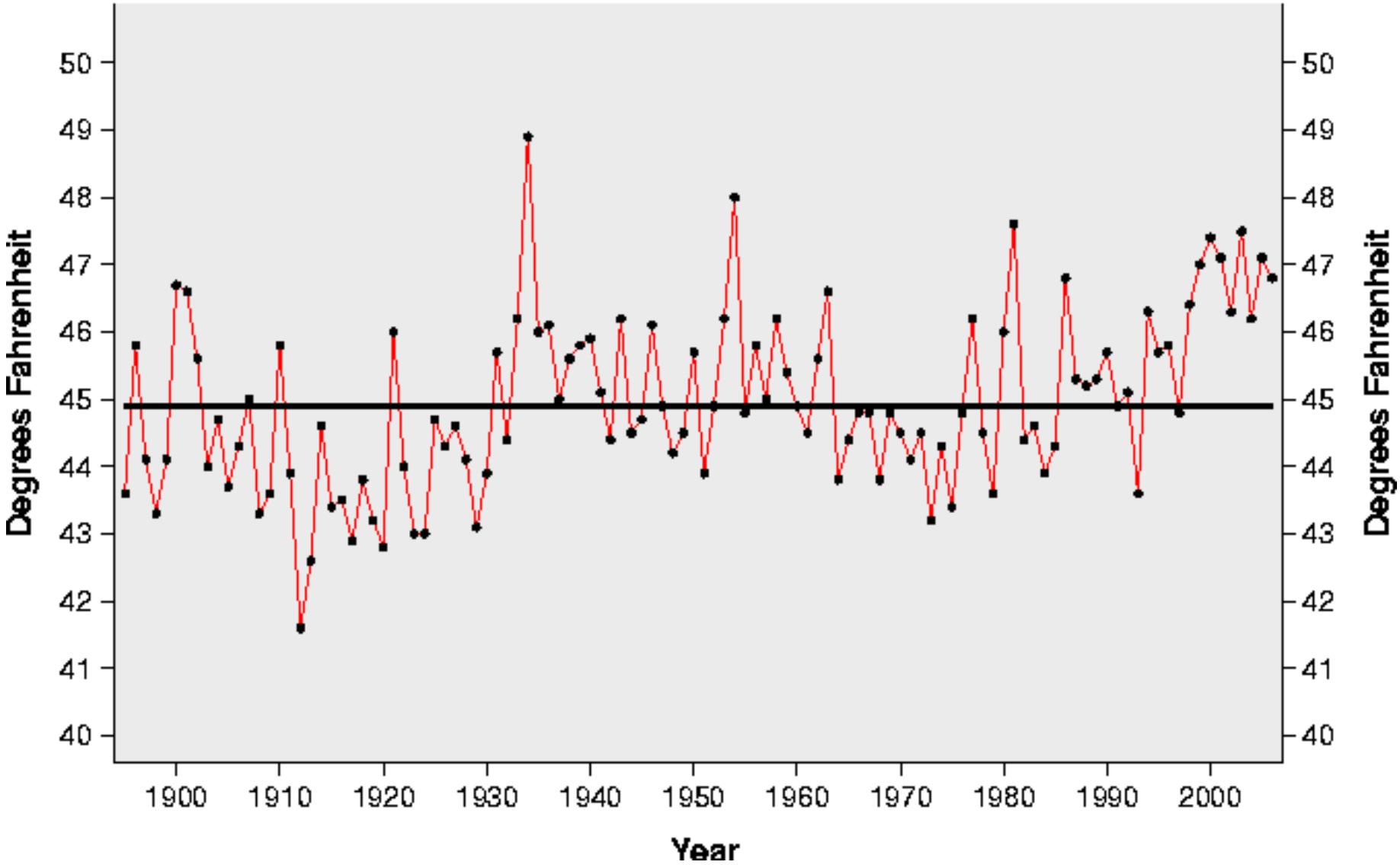
RURAL STATION



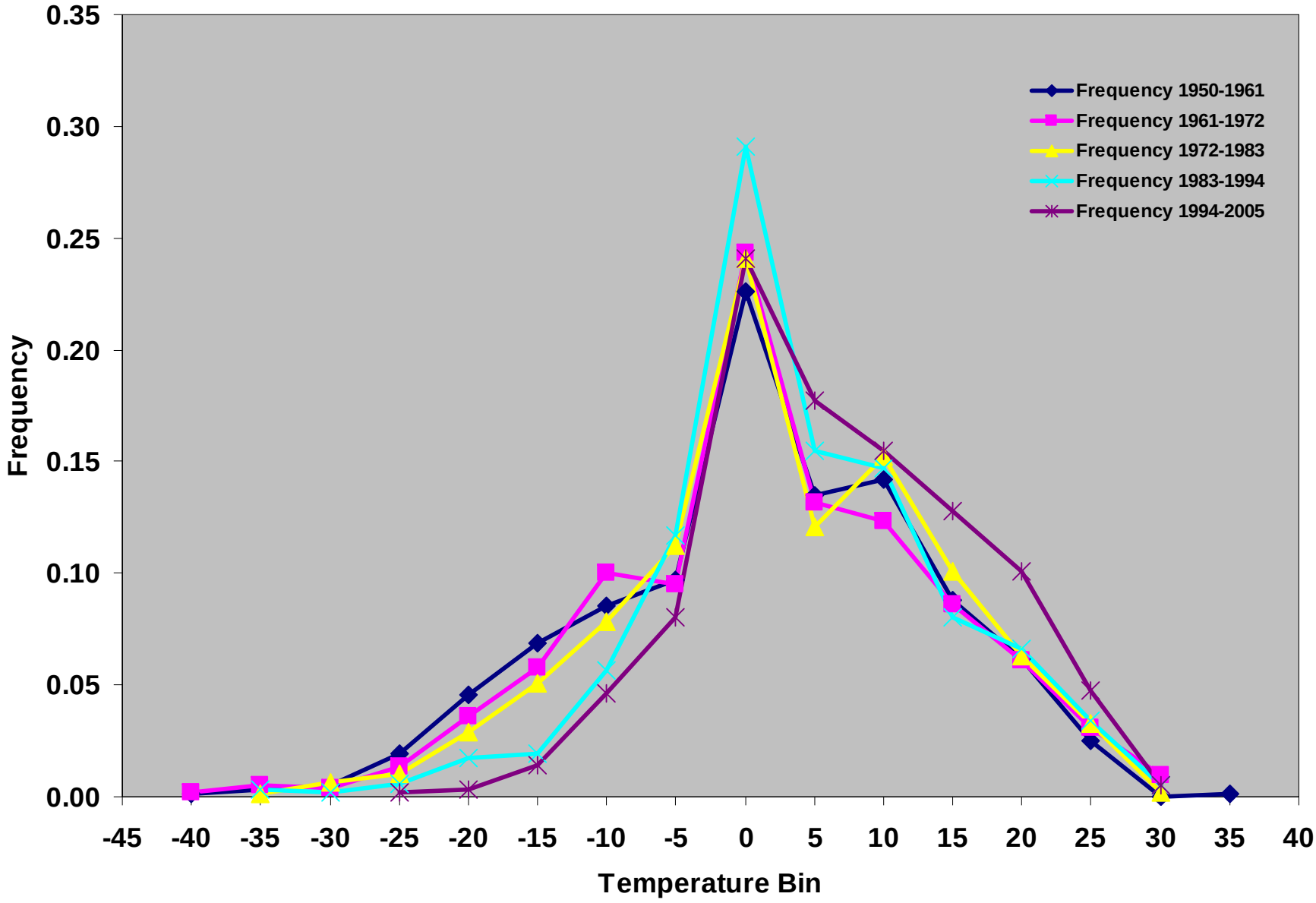
Akron 4E Fall (SON) Temperatures

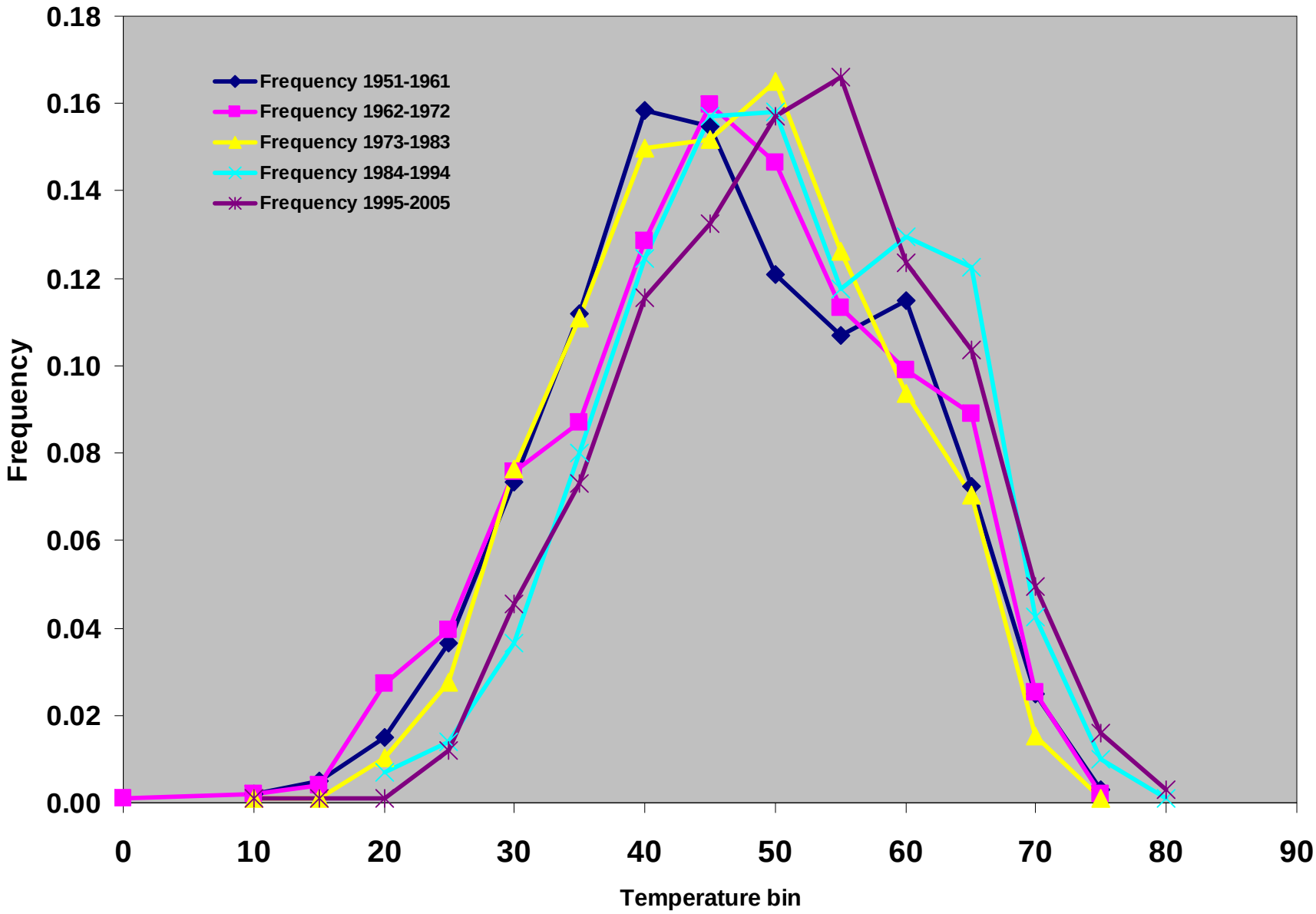


Colorado Statewide Mean Annual Temperature



Grand Lake, CO Winter Daily Minimum Temperature Distribution (5 degree bins)

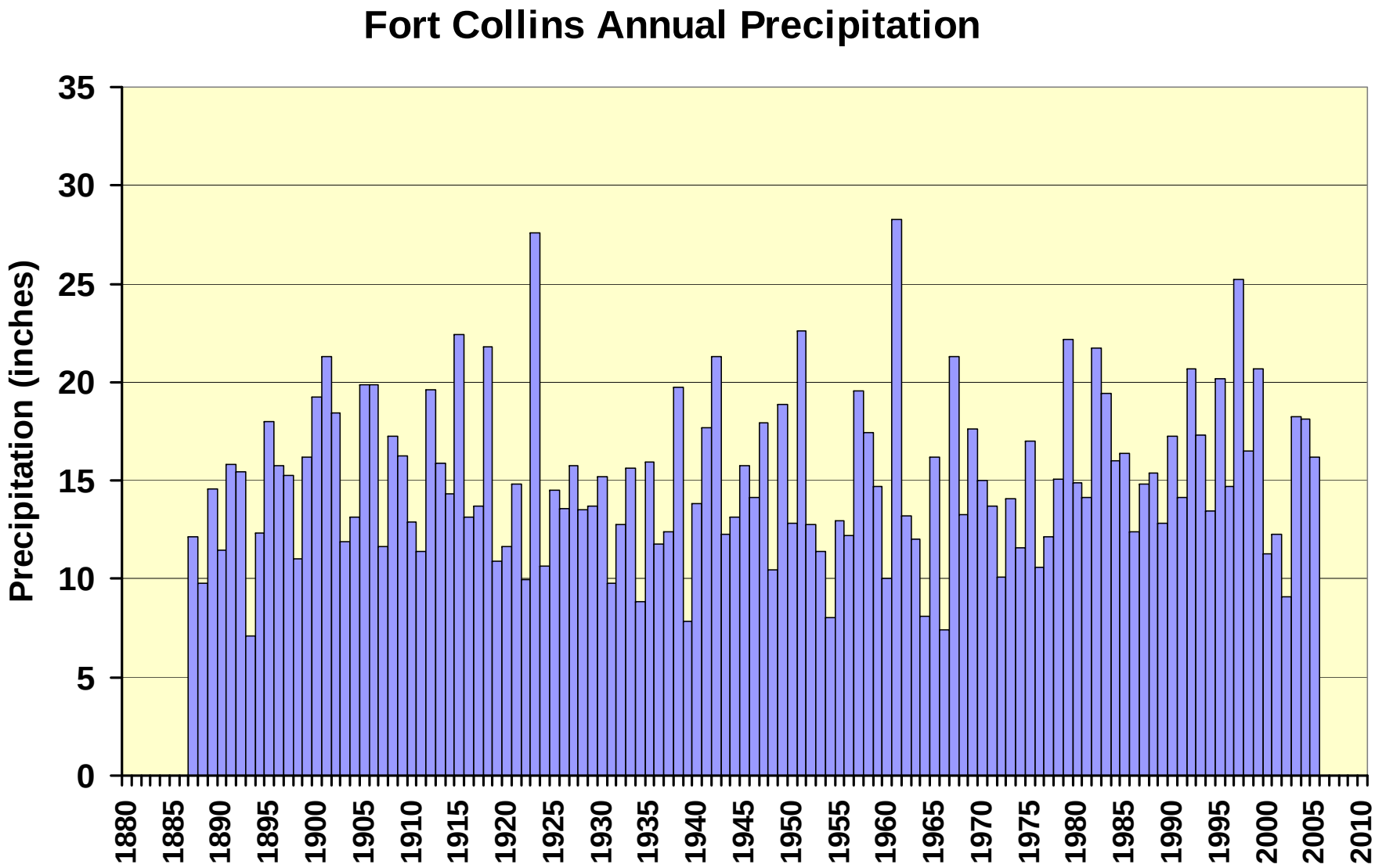



Grand Lake, CO Spring Daily Maximum Temperature Distribution
(5 degree bins)
Frequency 1951-1961
Frequency 1962-1972
Frequency 1973-1983
Frequency 1984-1994
Frequency 1995-2005
Frequency
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
10
20
30
40
50
60
70
80
90
Temperature bin

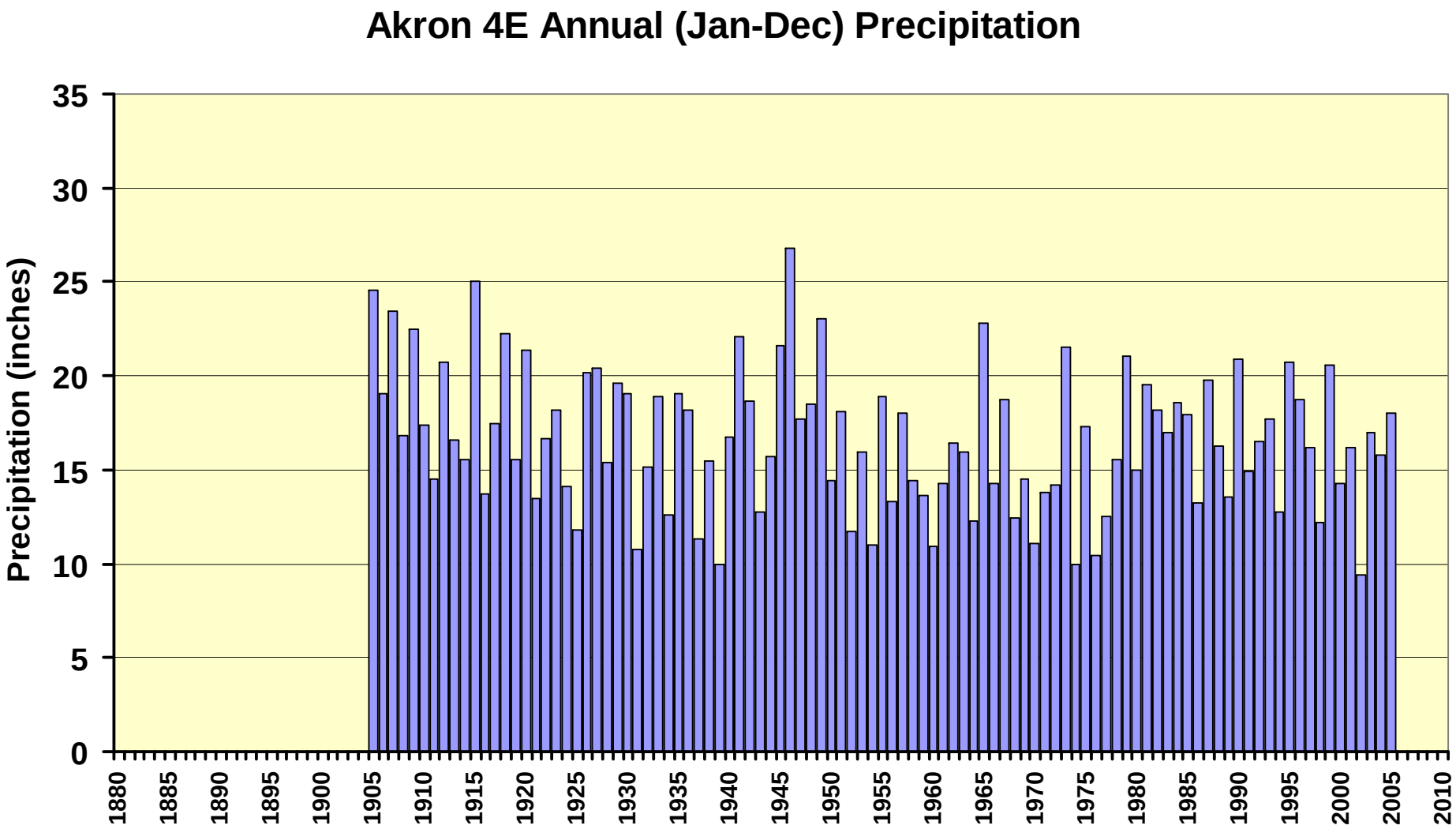
Precipitation

Photo by Wendy Ryan

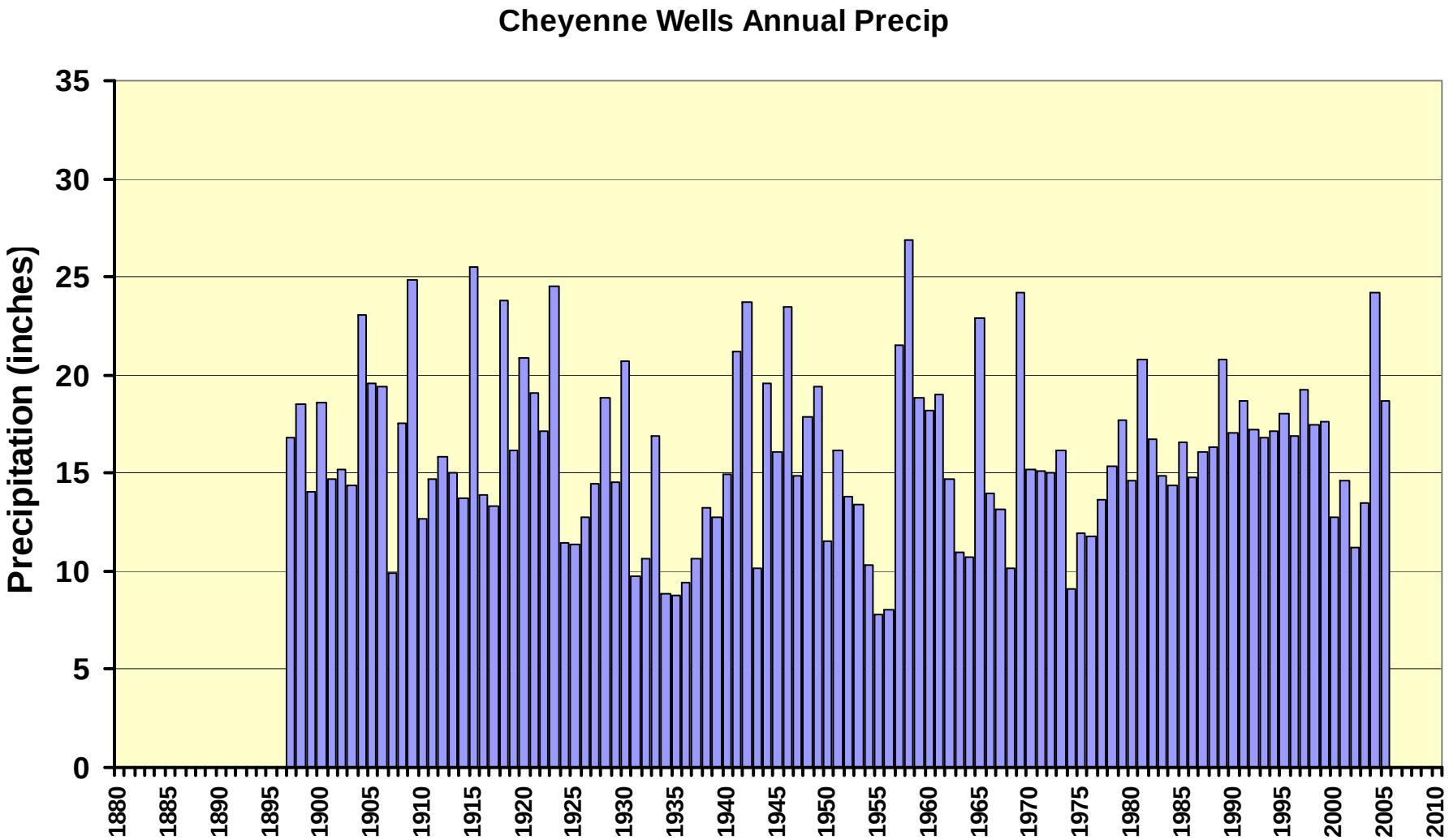
Fort Collins Precipitation



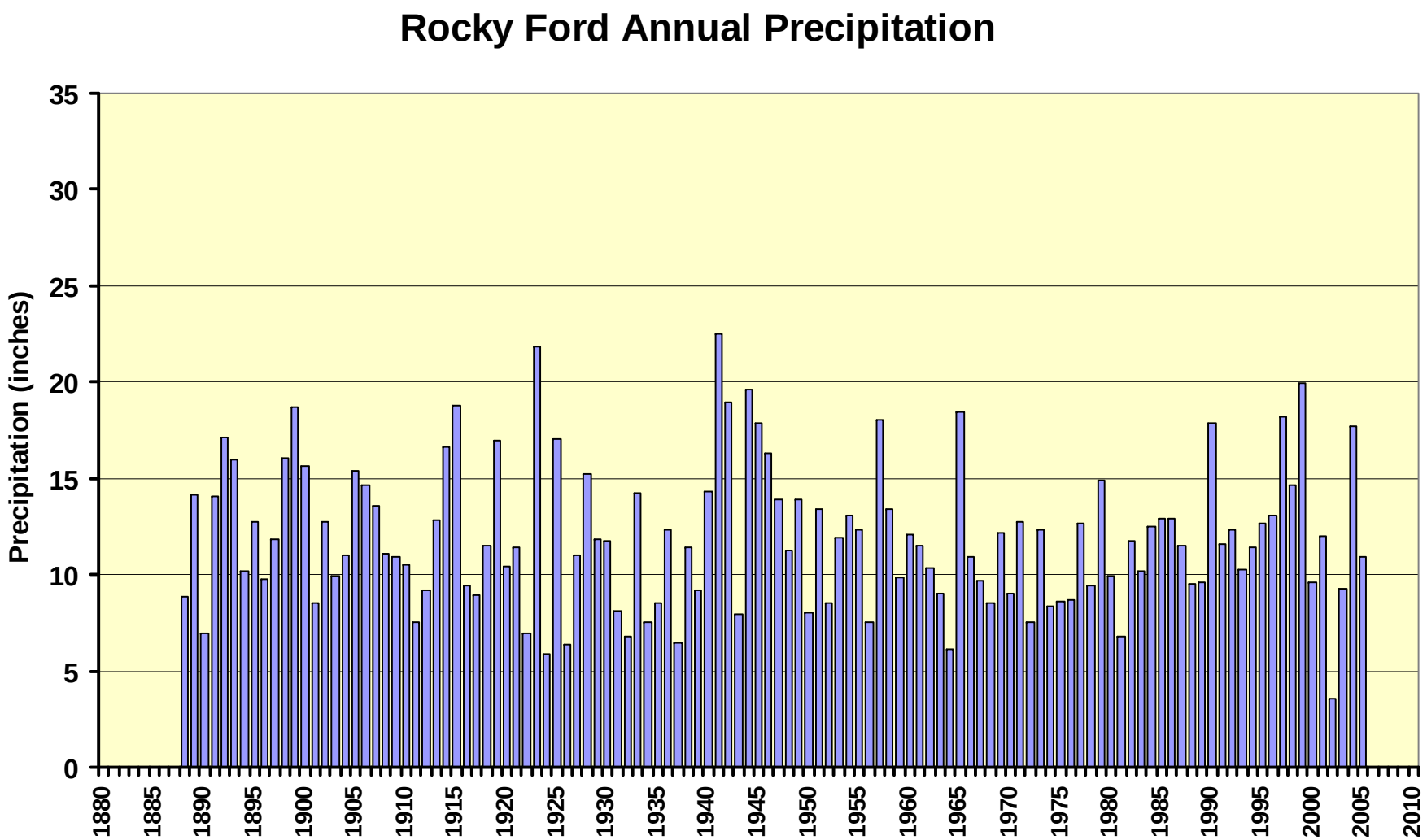
Akron Precipitation



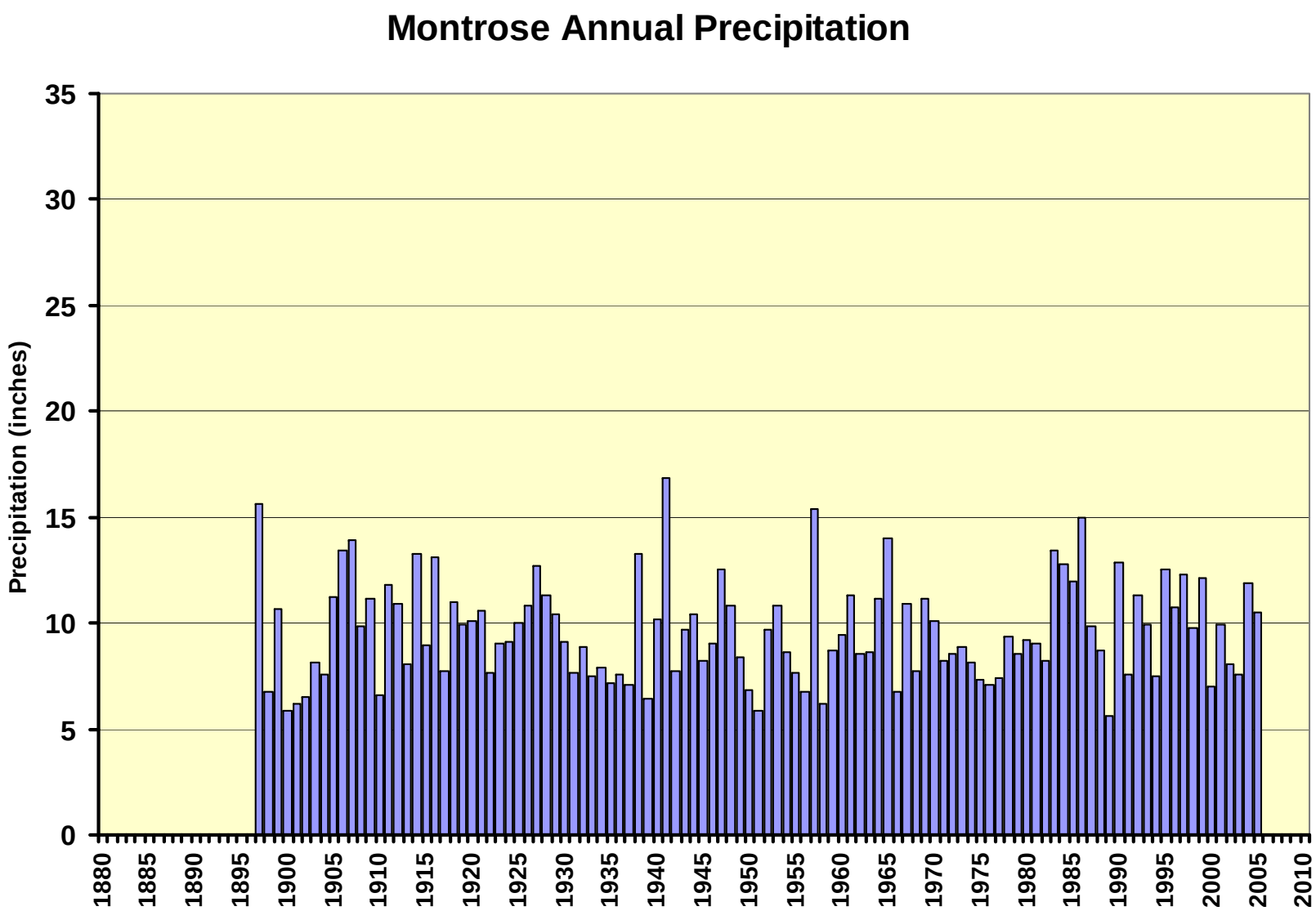
Cheyenne Wells Precipitation



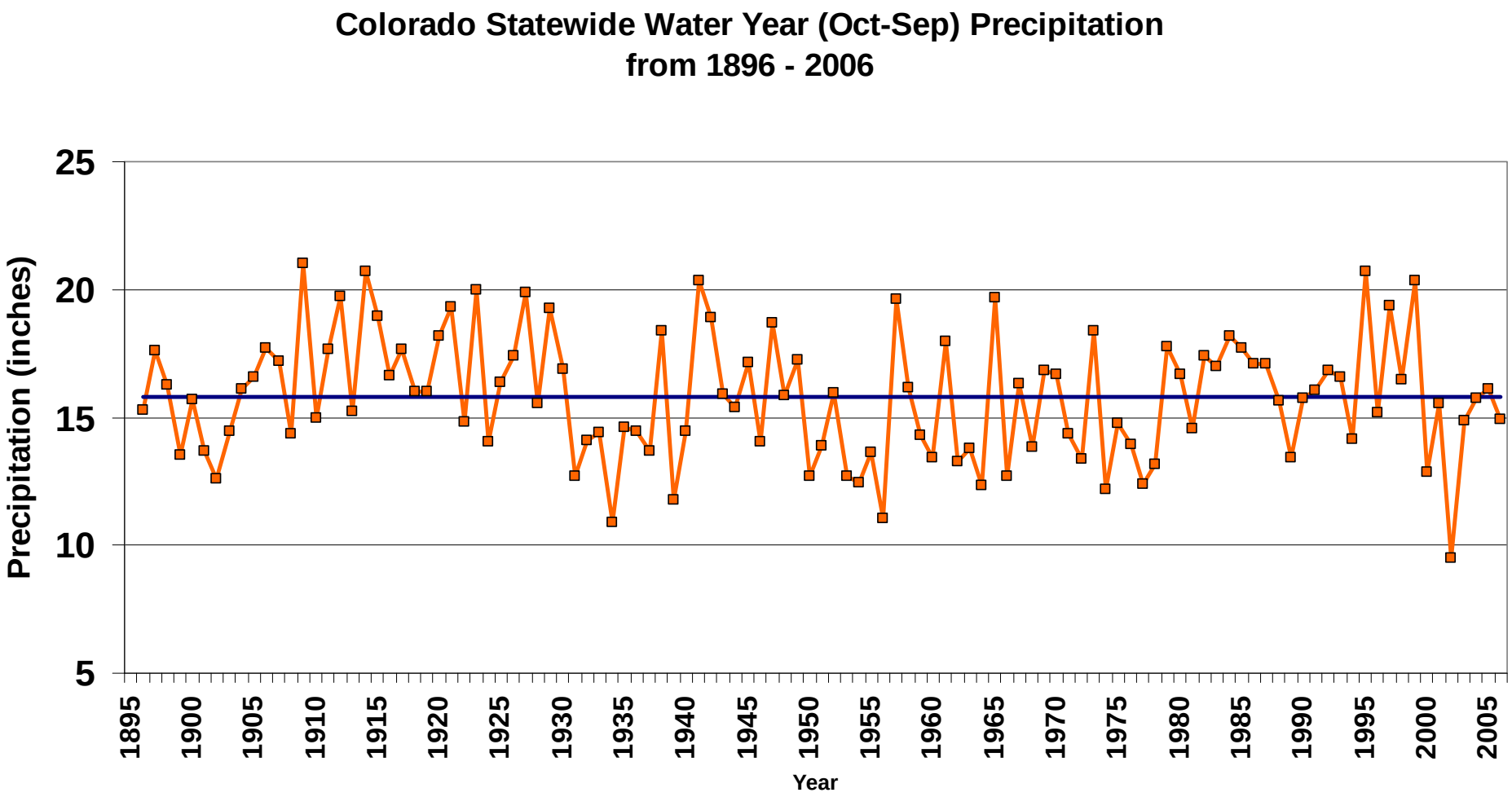
Rocky Ford Precipitation



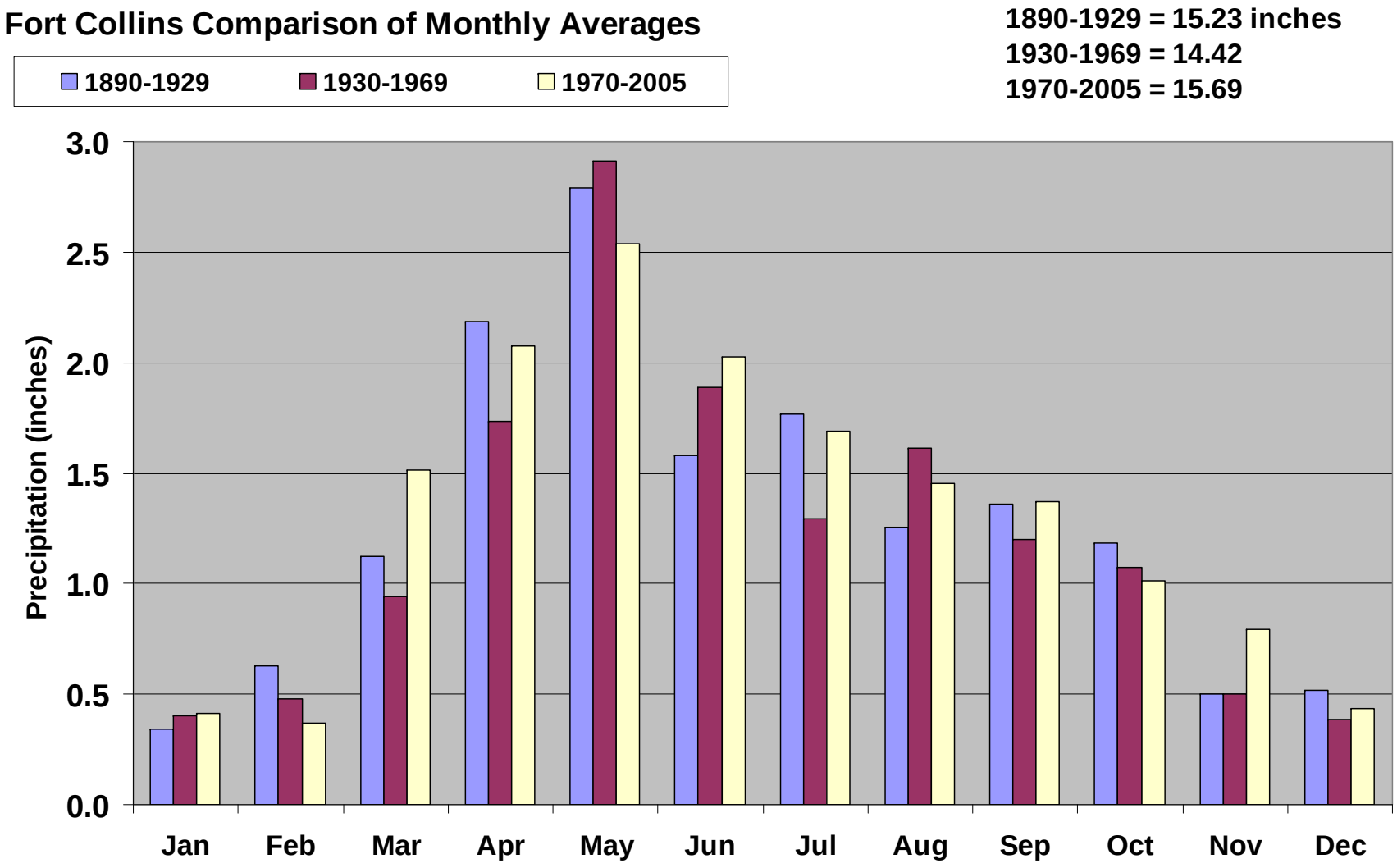
Montrose Precipitation



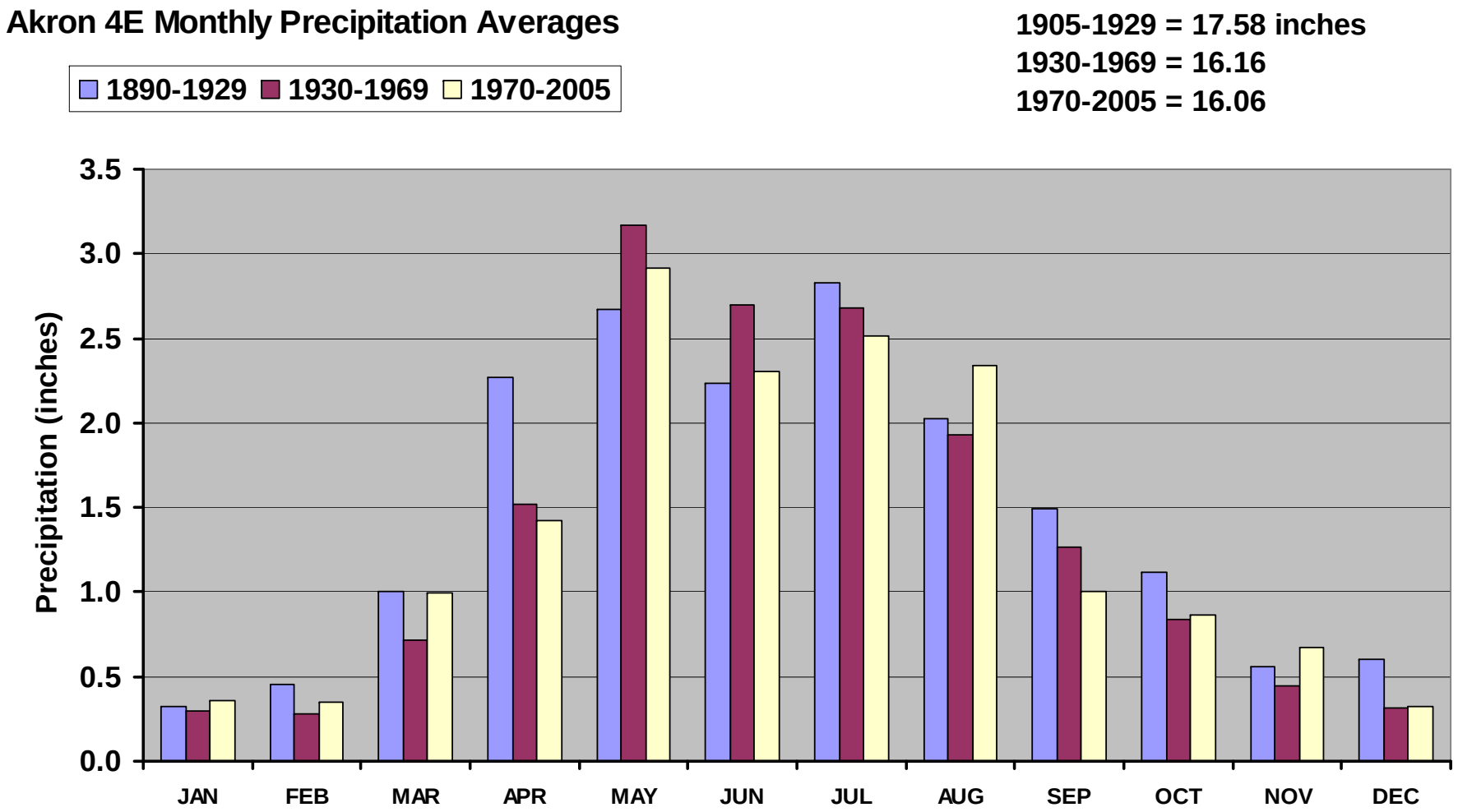
Colorado Statewide Water Year Precipitation



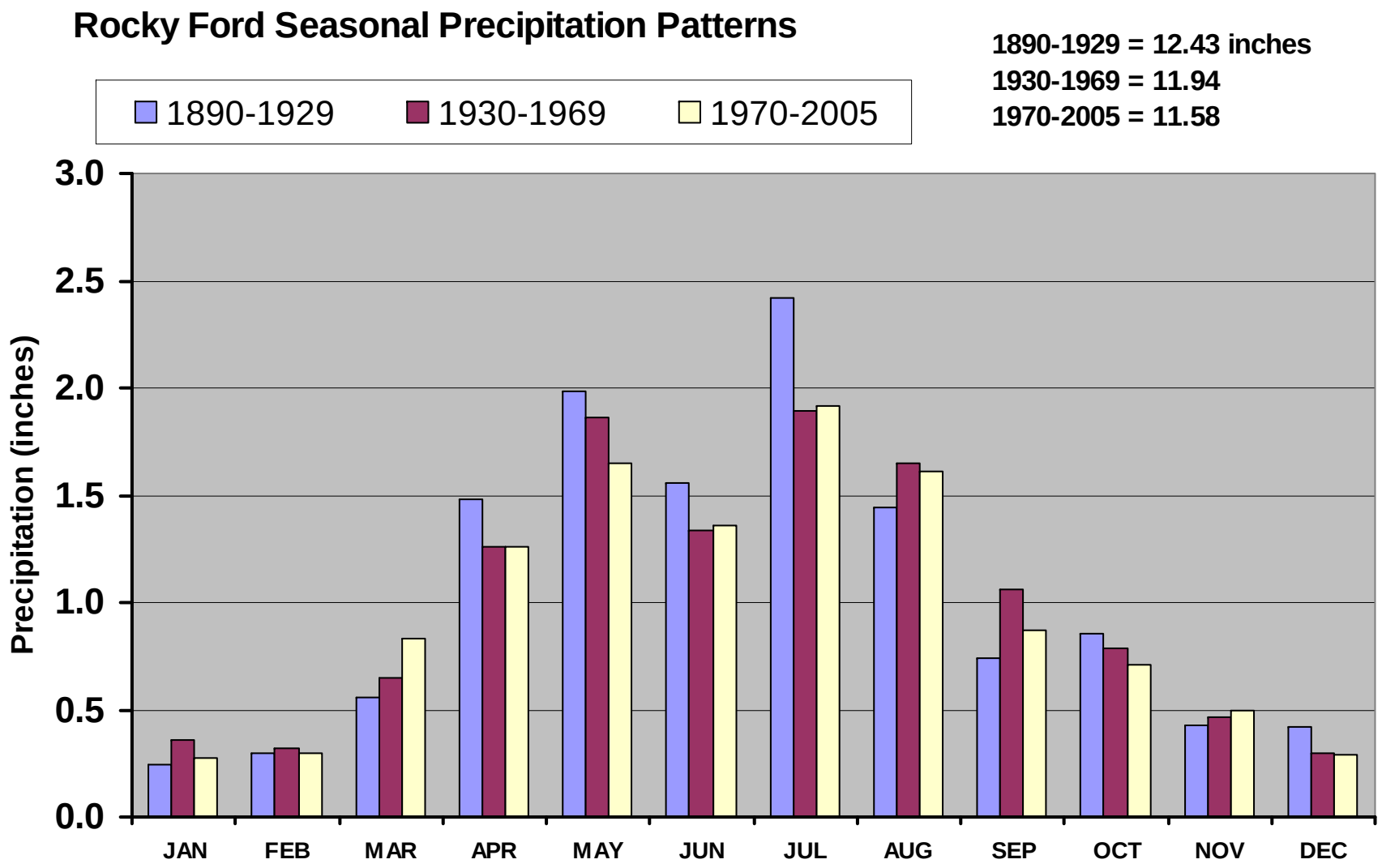
Fort Collins
Seasonal Patterns of Precipitation



Akron
Seasonal Patterns of Precipitation



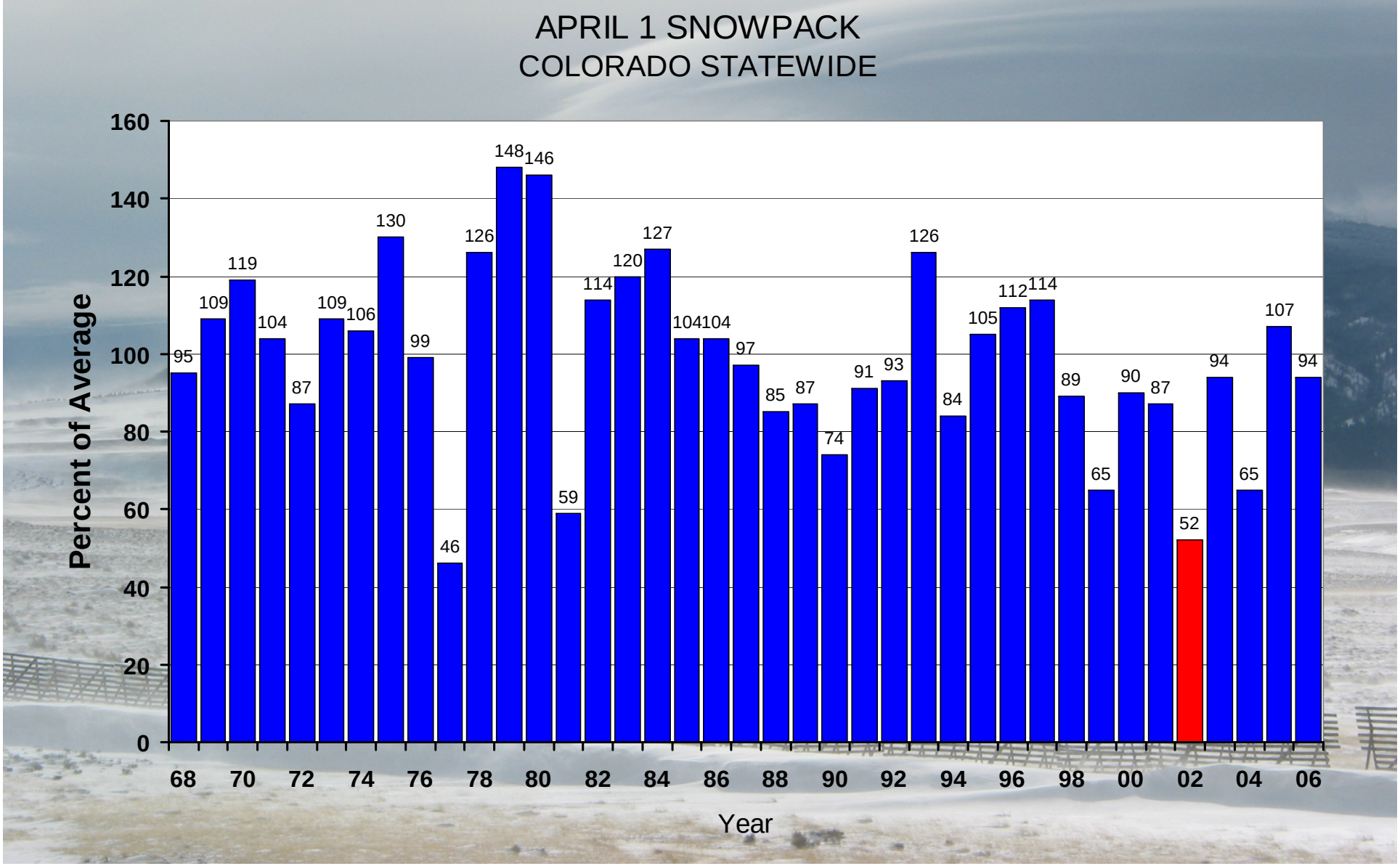
Rocky Ford
Seasonal Patterns of Precipitation



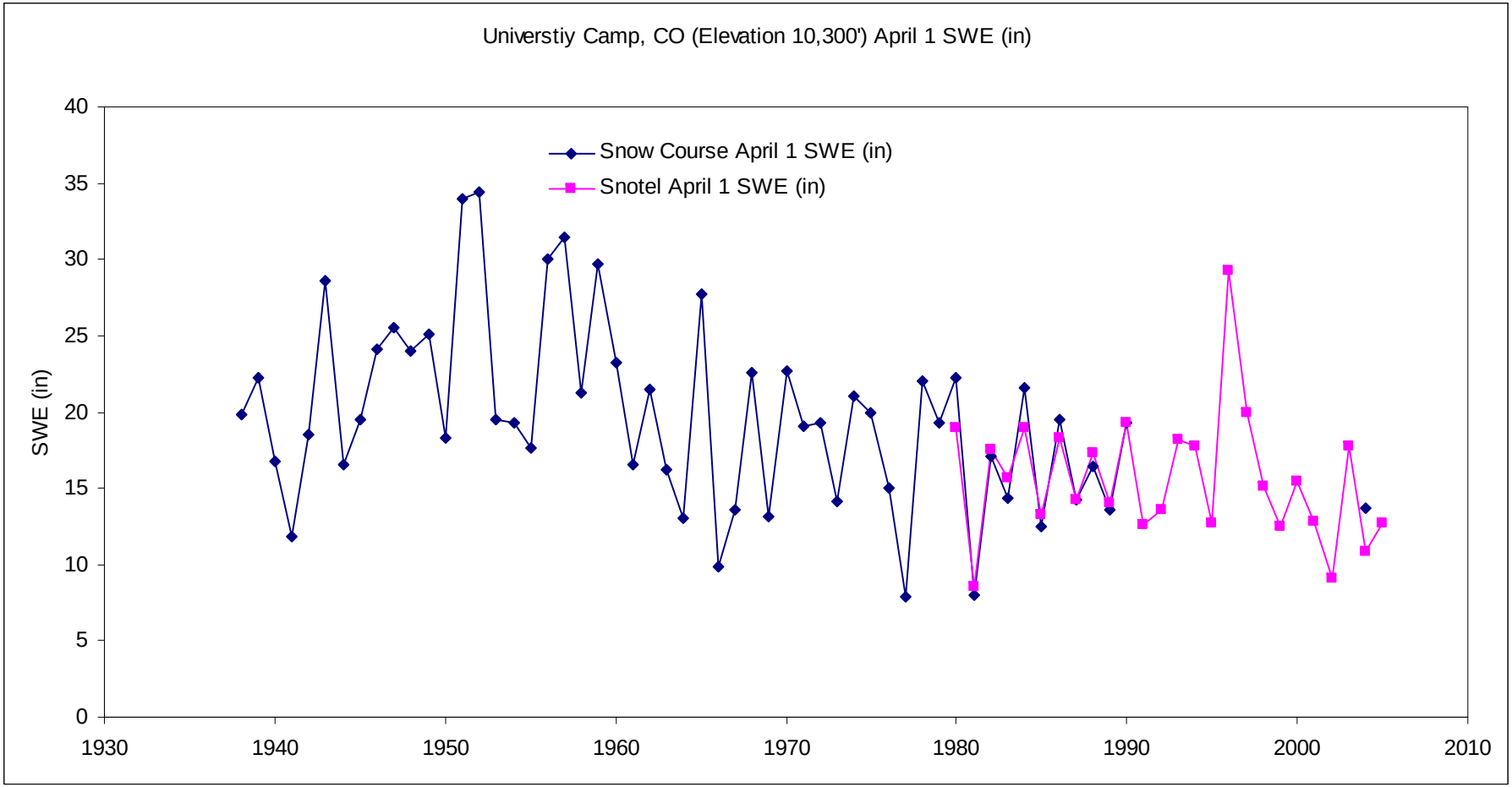
Mountain Snow!

Photo by Wendy Ryan

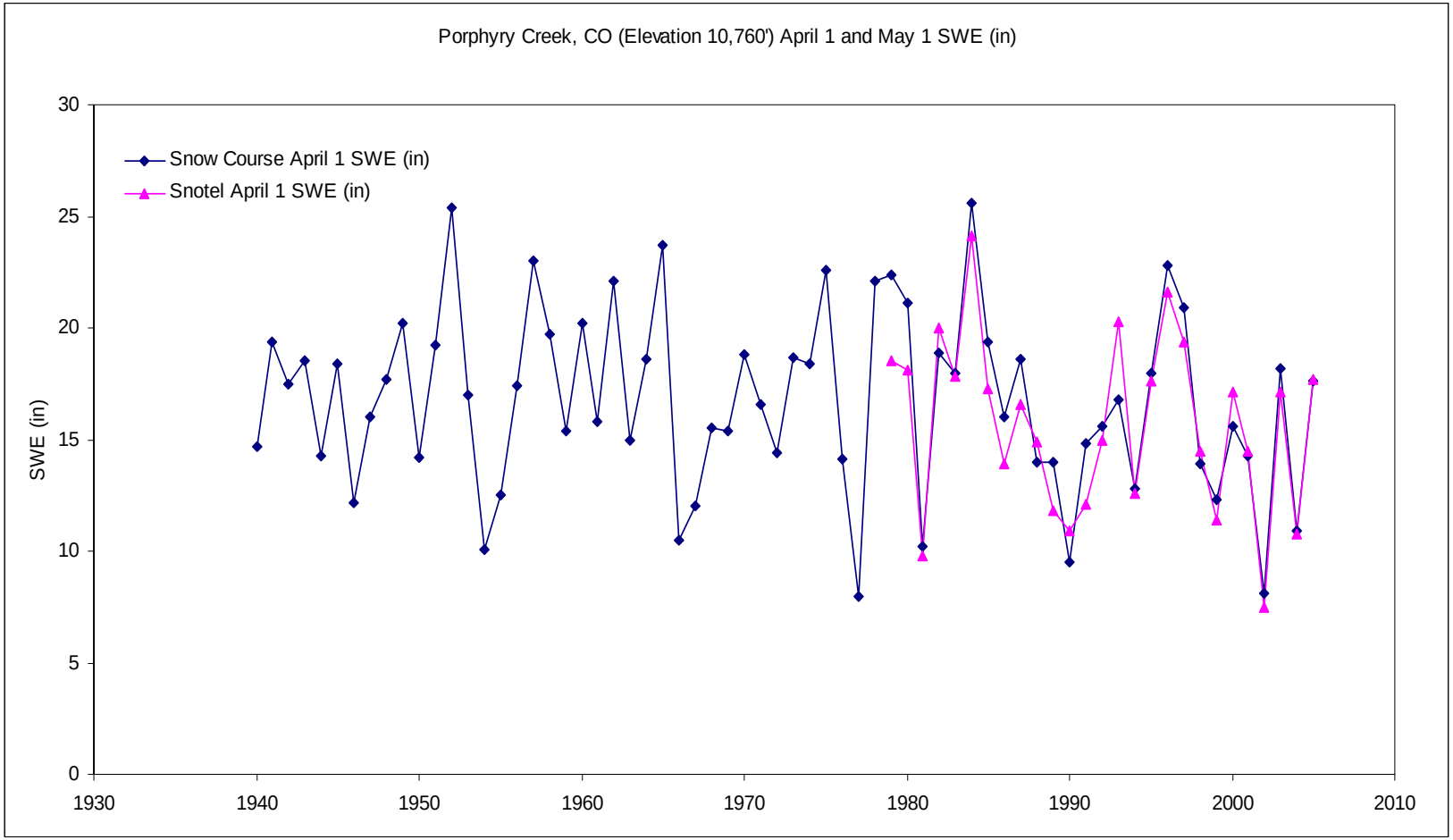
April 1 Colorado Snowpack



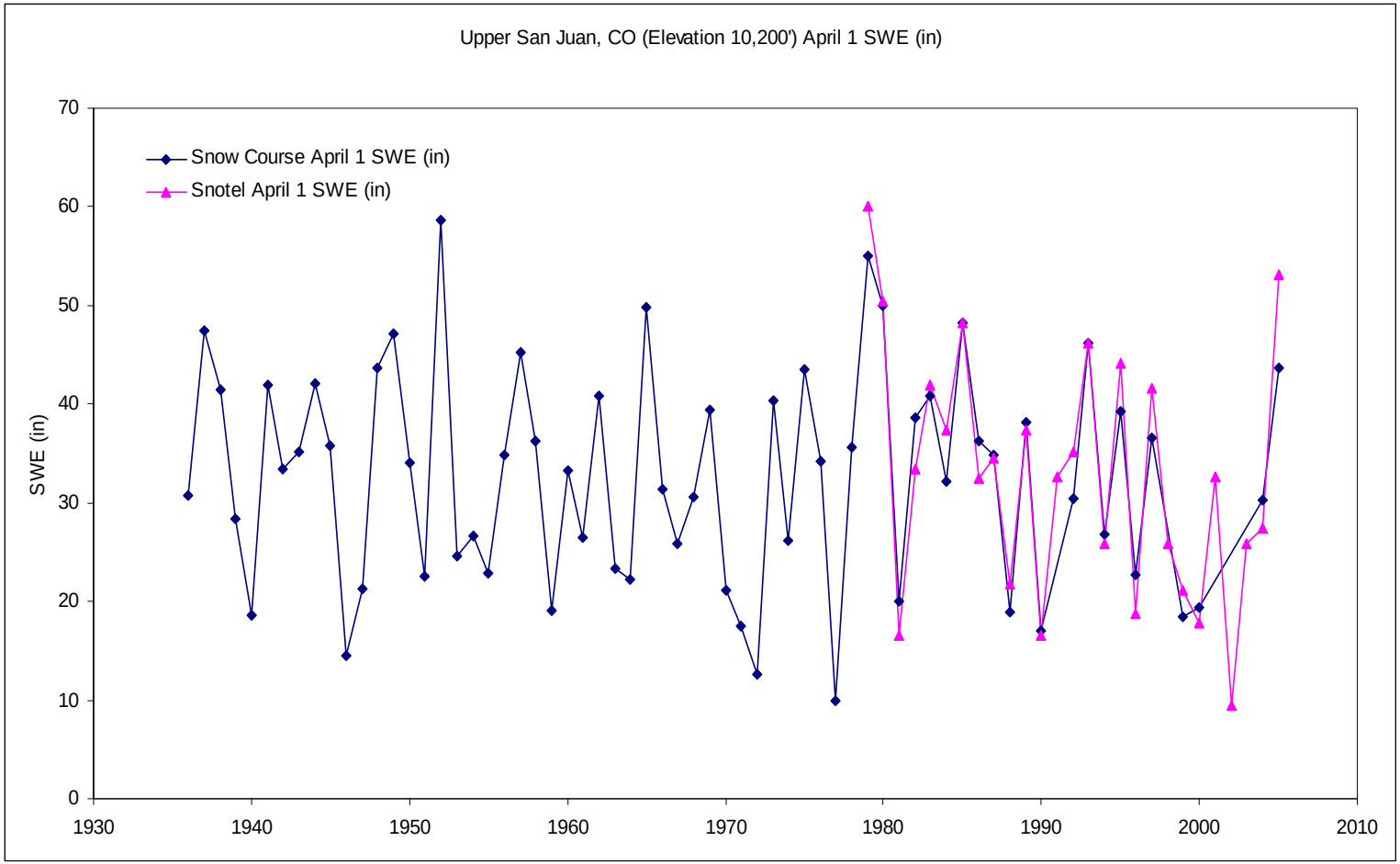
University Camp
April 1 Snow Course and Snotel



Porphyry Creek
April 1 Snow Course and Snotel

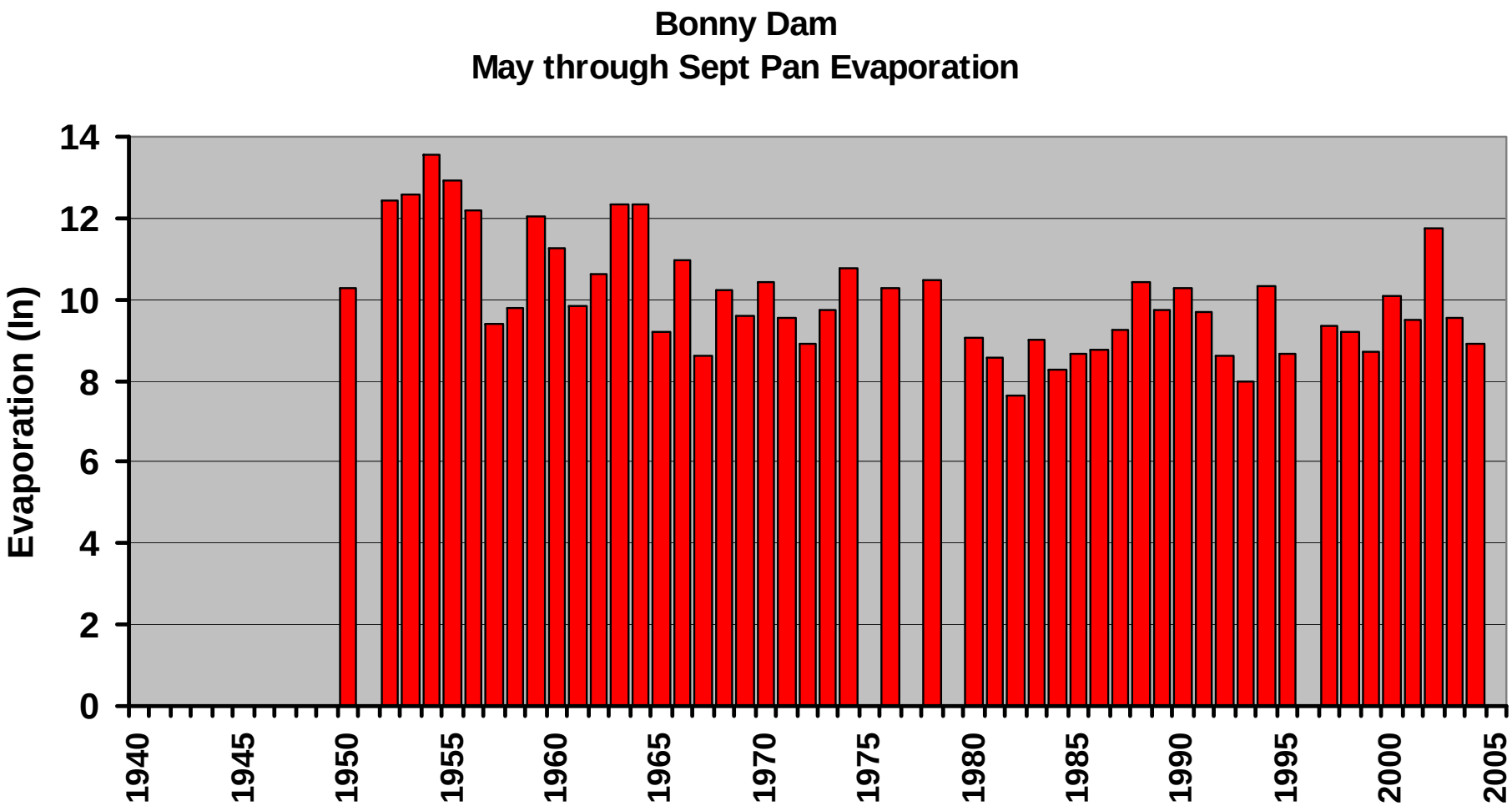


Upper San Juan
April 1 Snow Course and Snotel

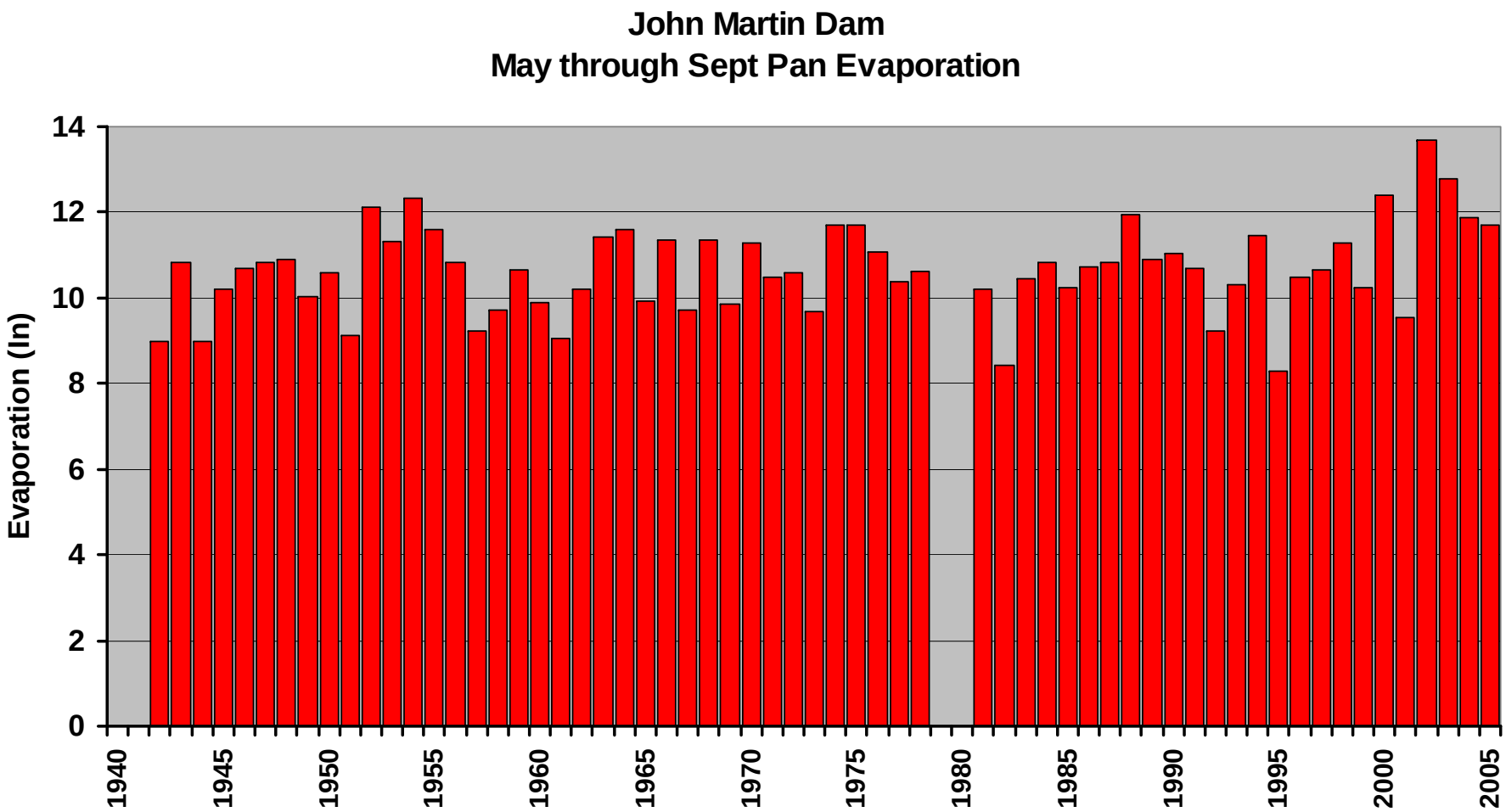



Evaporation

Bonny Dam Evaporation

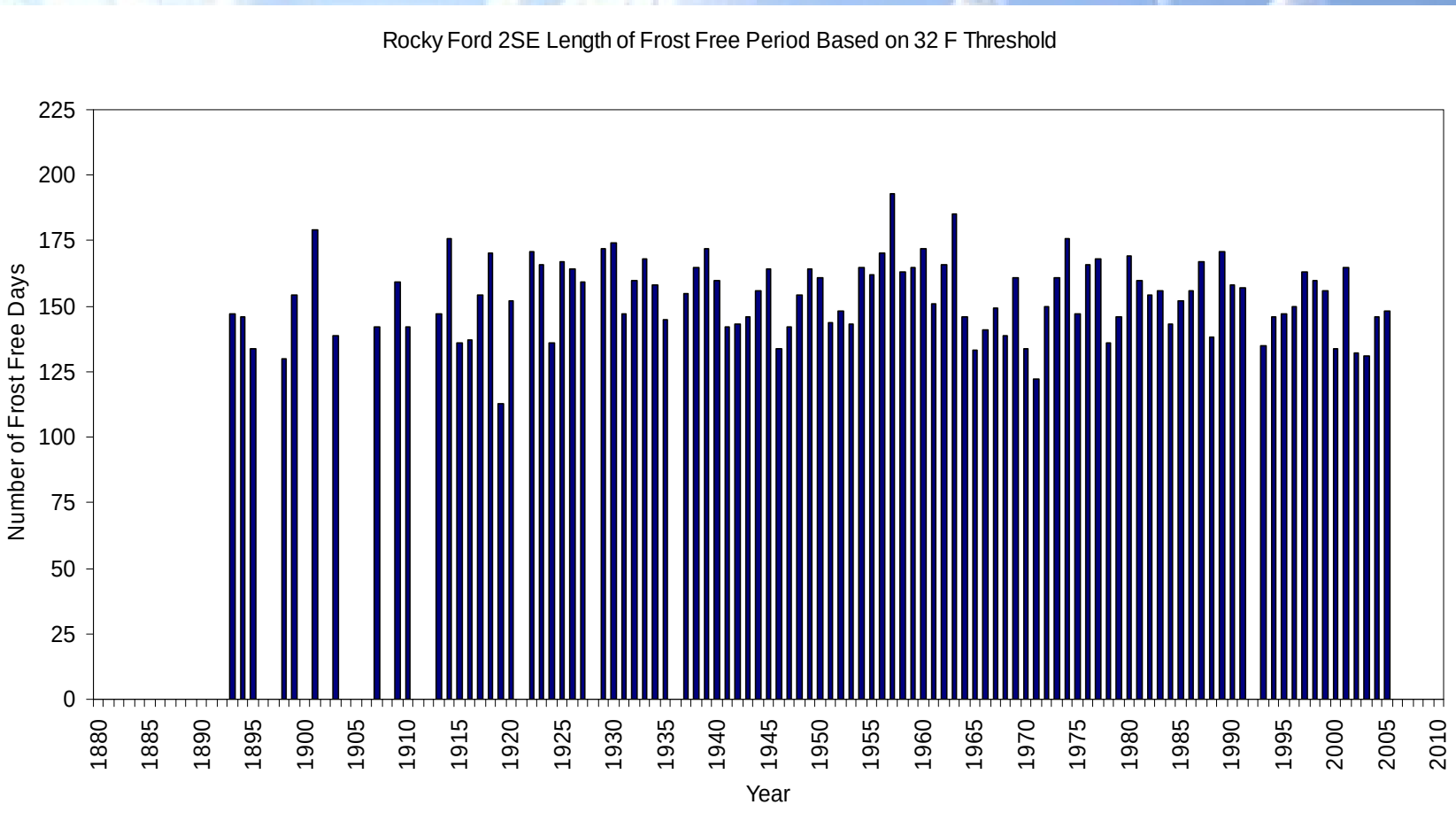


John Martin Dan Evaporation

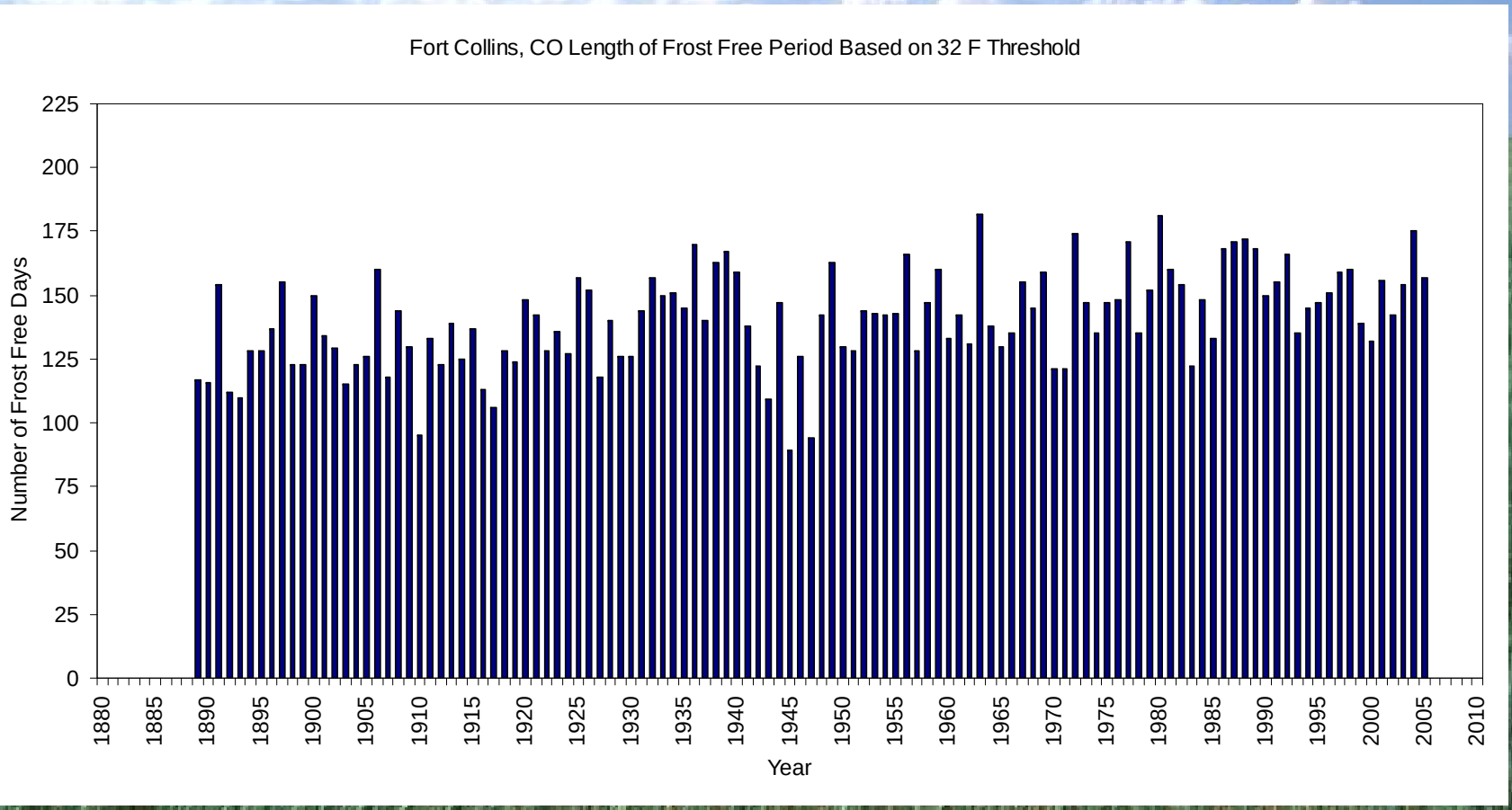



Frost Free Days
(Growing Season)

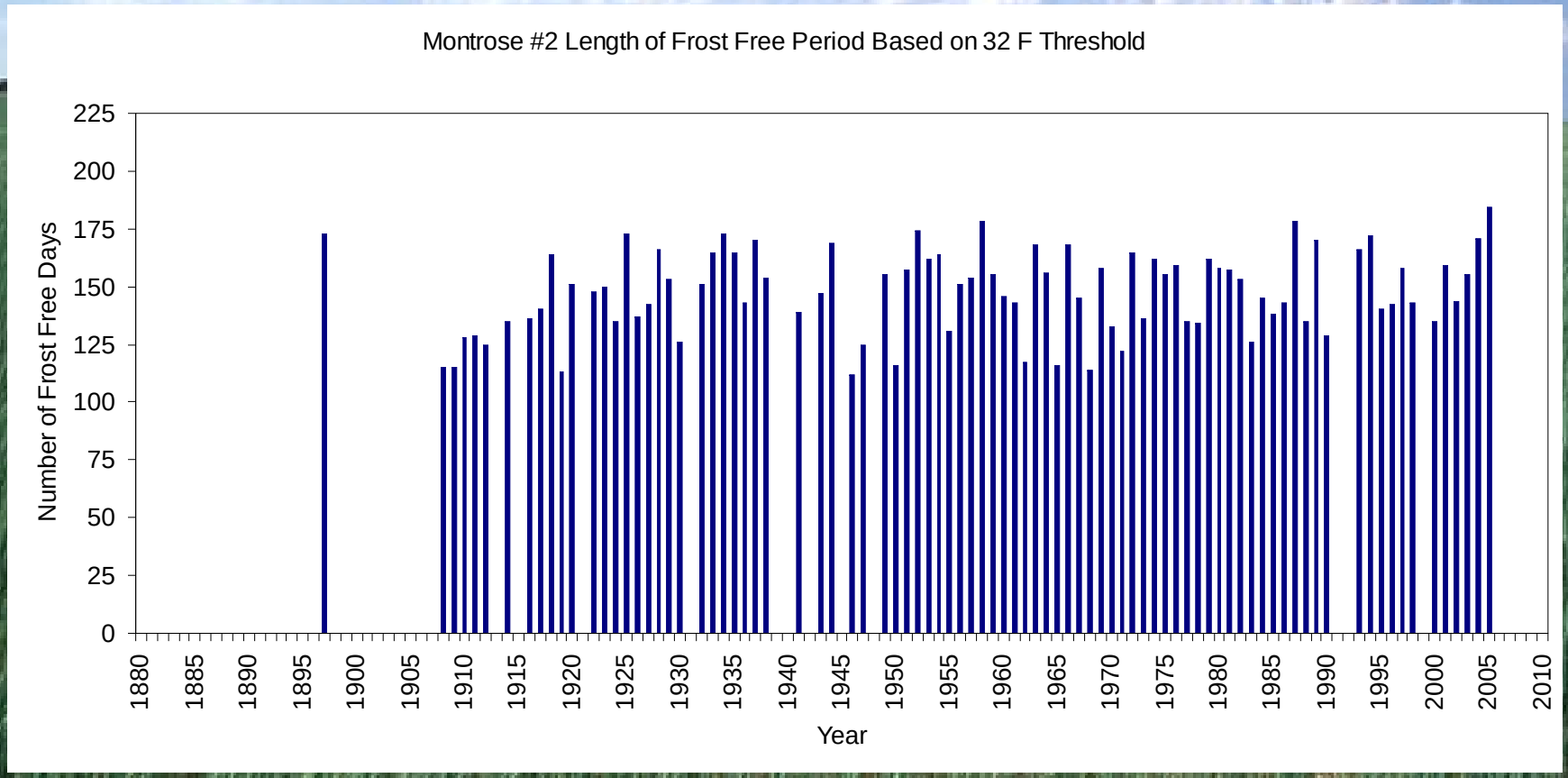
Rocky Ford
Frost Free Days



Fort Collins
Frost Free Days

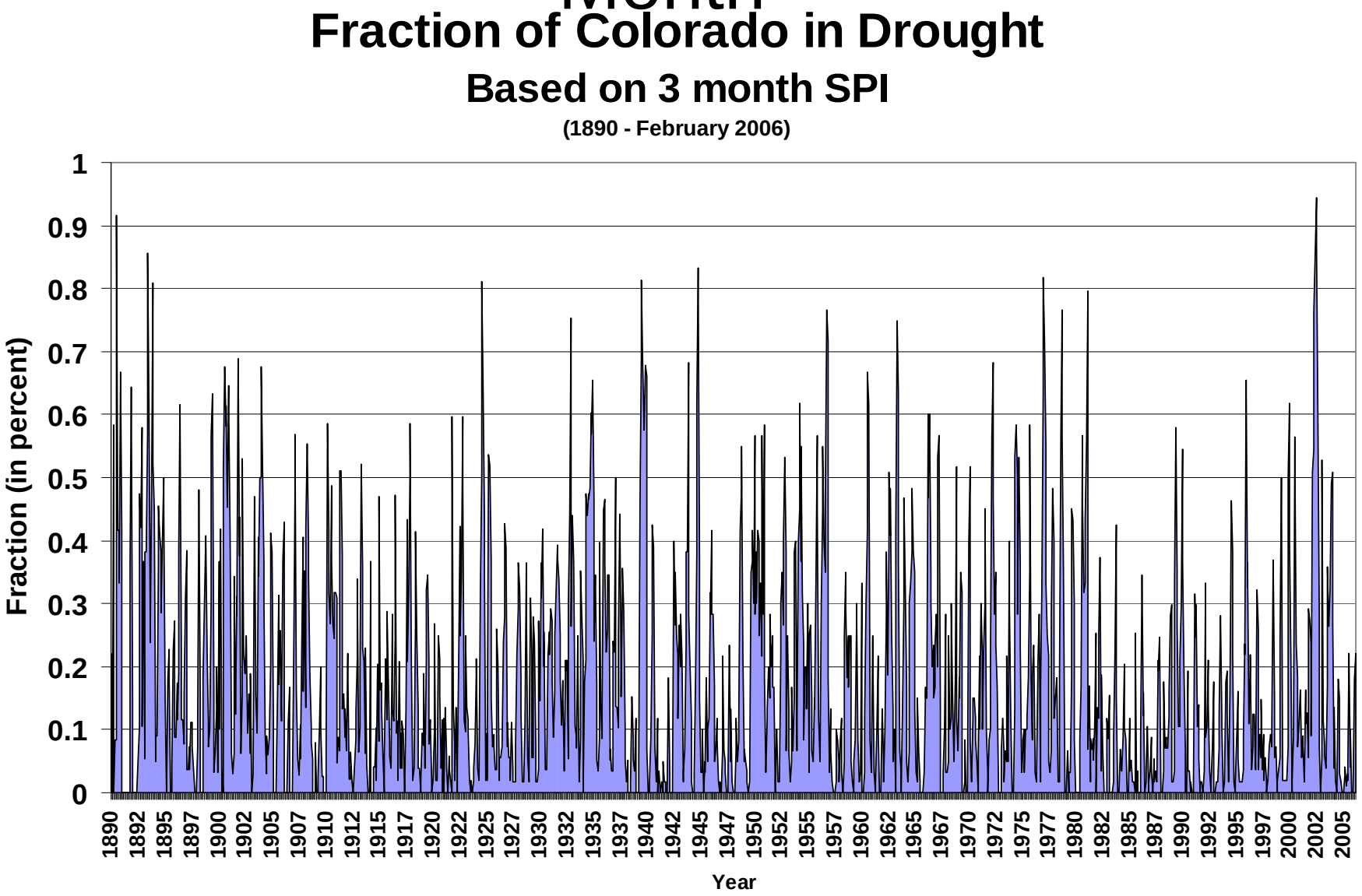


Montrose
Frost Free Days




Drought

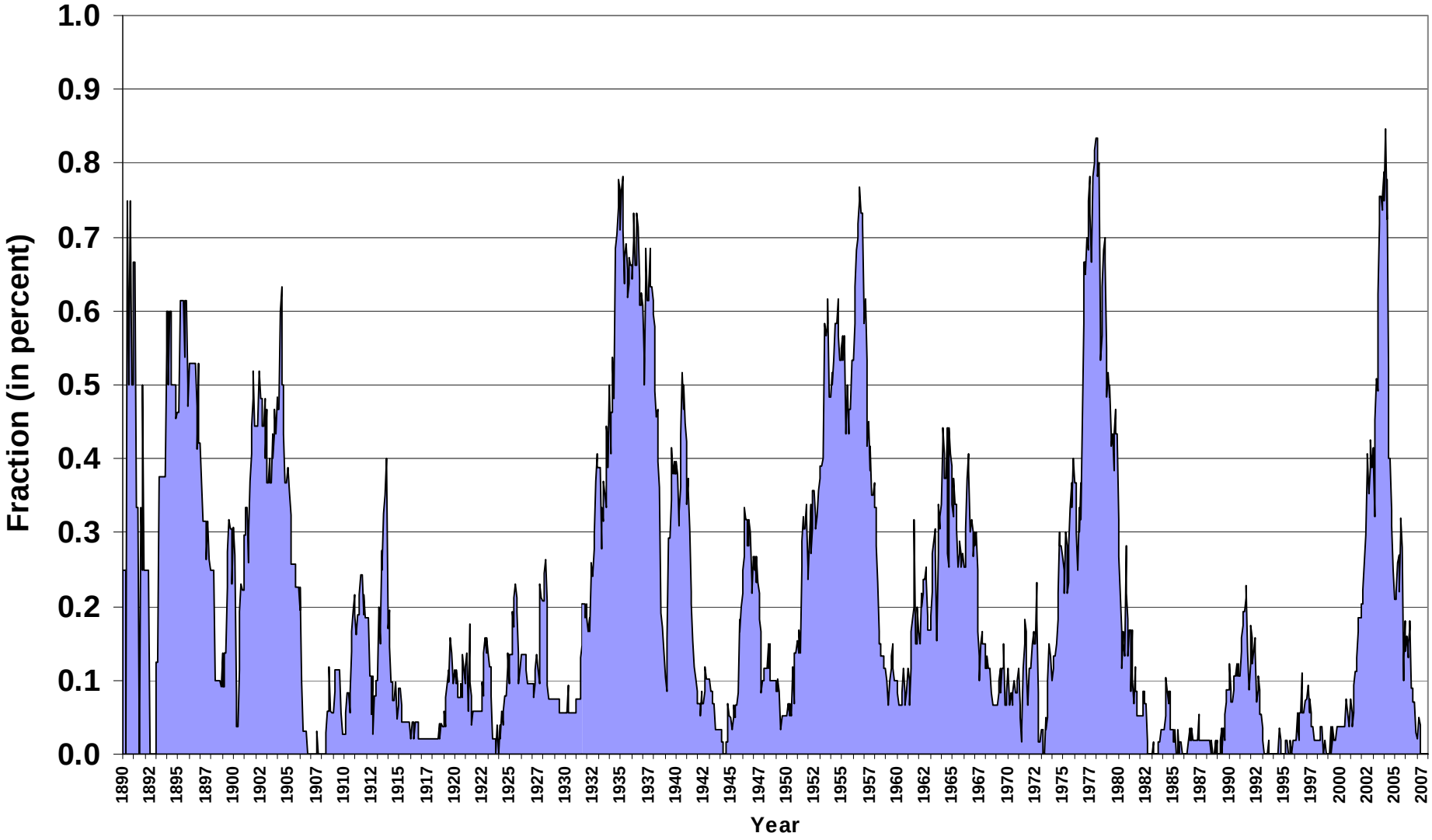
Standardized Precipitation Index 3 Month



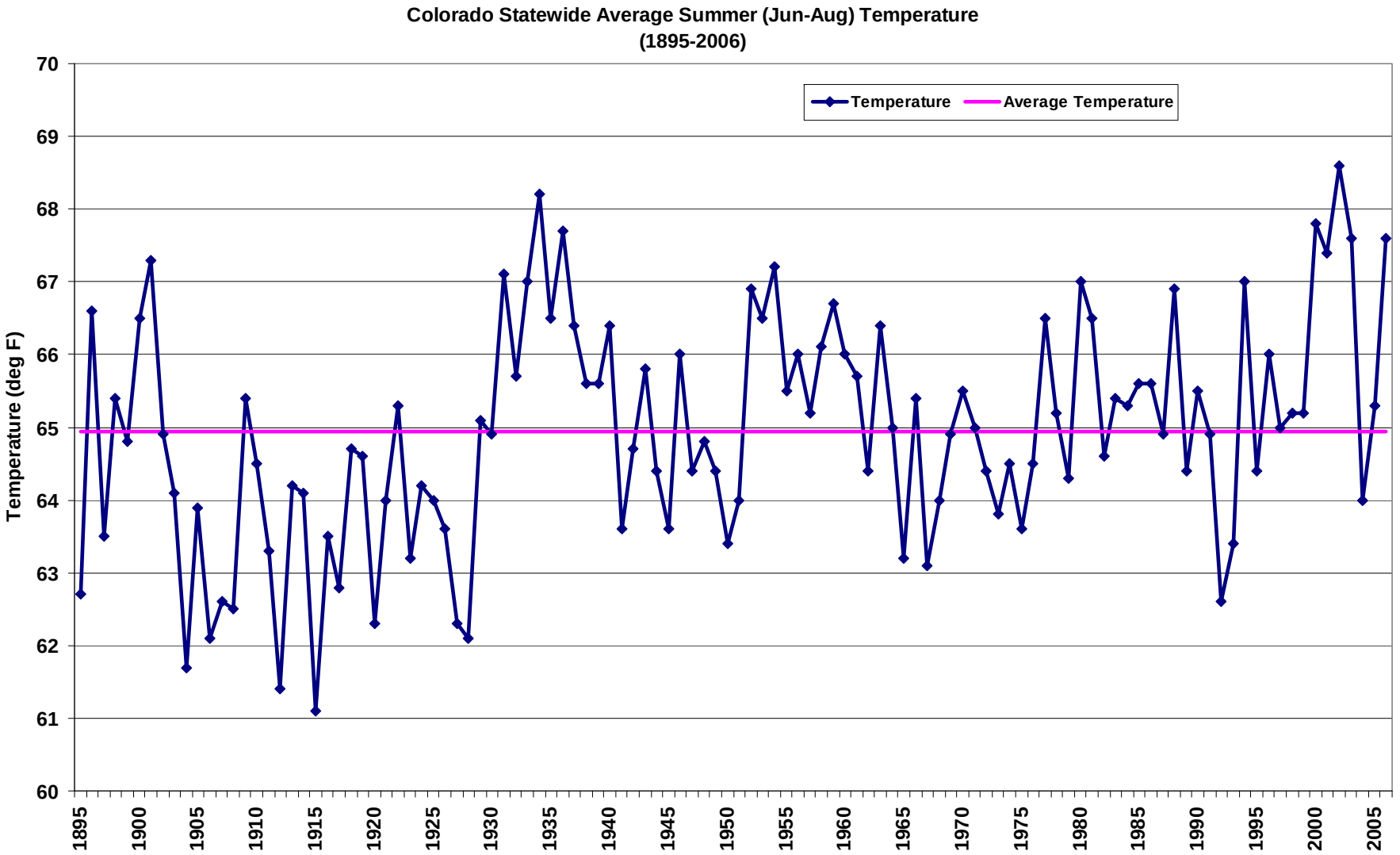
Fraction of Colorado in Drought

Based on 48 month SPI

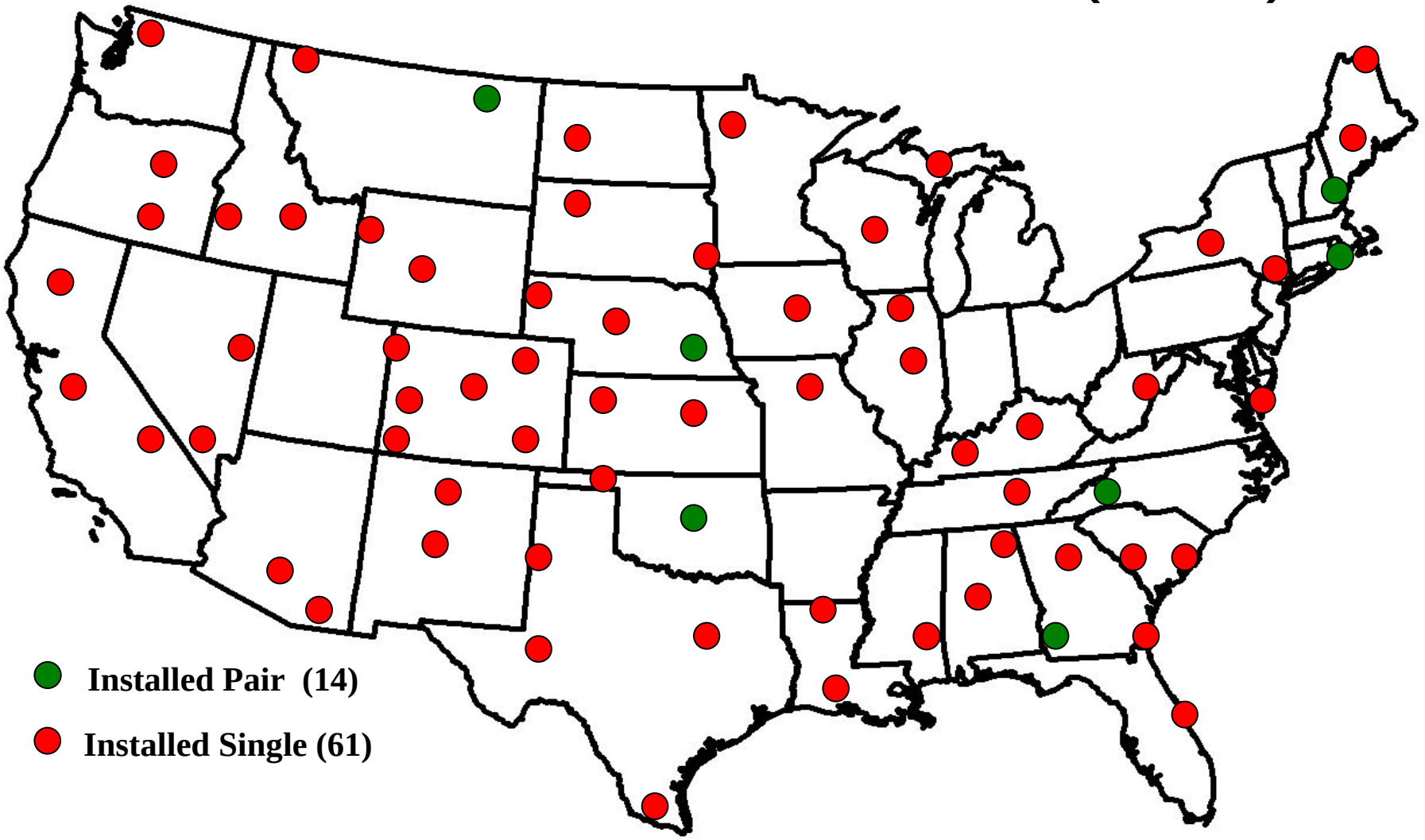
(1890 - Apr 2007)



We will be monitoring the situation closely

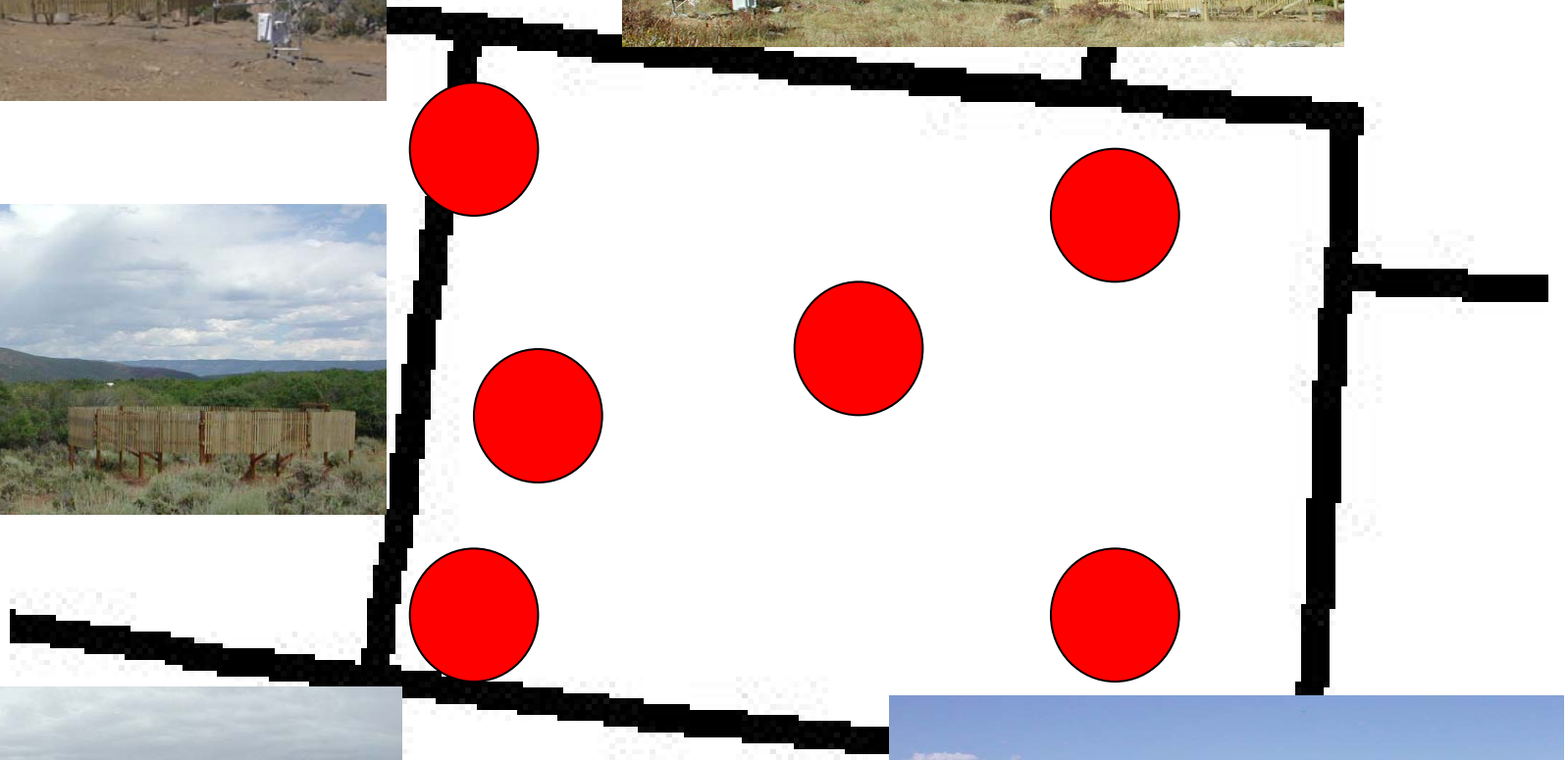


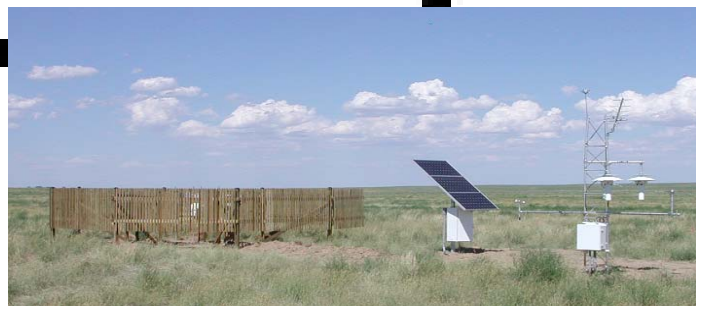
NOAA National Climatic Data Center's Climate Reference Network (CRN)



http://www.ncdc.noaa.gov/oa/climate/uscrn/program.html

Climate Reference Network (CRN)






The End!?!

Colorado Climate Center

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu

- click on “Drought”
- then click on “Presentations”

Colorado State University
Knowledge to Go Places

Colorado Climate Center