Living in the Past – What Does Colorado's Historic Weather Data Show Us?

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Presented at 17th Annual South Platte Forum,
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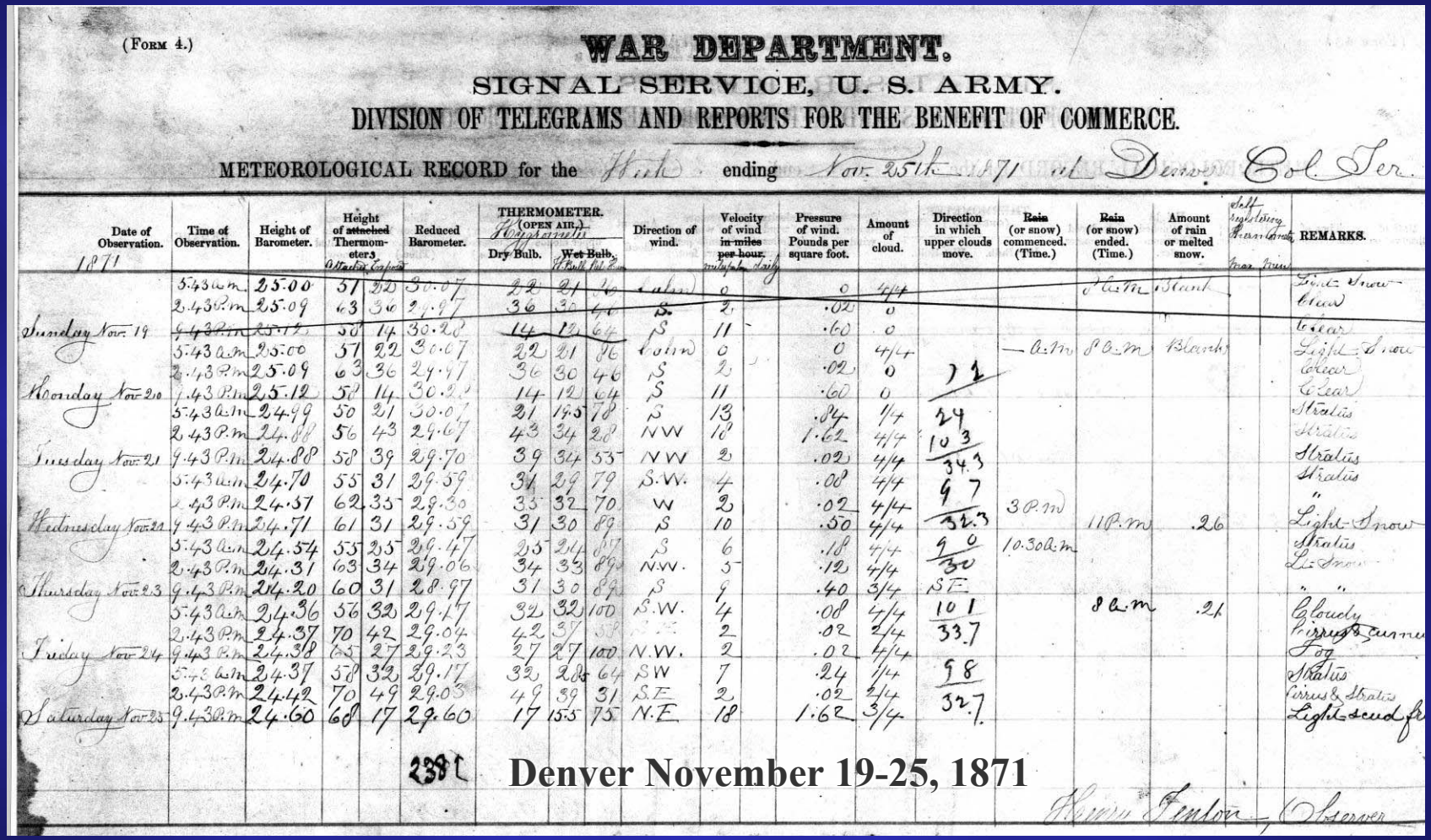
Prepared by Odie Bliss, Wendy Ryan and Daniel Denison

Colorado State University
Knowledge to Go Places

Systematic weather data collection began in the South Platte Basin and in other parts of Colorado in the early 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 ~~attached~~ Thermometers Attached	Height of ~~attached~~ Thermometers Exposed	Reduced Barometer.	Thermometer (Open Air) Hygrometer Dry Bulb.	Thermometer (Open Air) Hygrometer Wet Bulb.	Thermometer (Open Air) Hygrometer Wet Bulb.	Direction of wind.	Velocity of wind ~~in 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 Thermometer Max	Self registering Thermometer Min	REMARKS.
	5.43 a.m.	25.00	57	22	30.07	22	21	86	Calm	0	0	4/4			8 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	57	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	10 3						Stratus
Tuesday Nov. 21	9.43 P.m.	24.88	58	39	29.70	39	34	55	NW	2	.02	4/4	34.3						Stratus
	5.43 a.m.	24.70	55	31	29.59	31	29	79	S.W.	4	.08	4/4	9 7						Stratus
	2.43 P.m.	24.57	62	35	29.30	35	32	70	W	2	.02	4/4		3 P.m.					"
Wednesday Nov. 22	9.43 P.m.	24.71	61	31	29.59	31	30	89	S	10	.50	4/4	32.3		11 P.m.	.26			Light Snow
	5.43 a.m.	24.54	55	25	29.47	25	24	87	S	6	.18	4/4	9 0	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	10 1		8 a.m.	.21			Cloudy
	2.43 P.m.	24.37	70	42	29.04	42	37	58	[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	28.5	64	SW	7	.24	1/4	9 8						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

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.

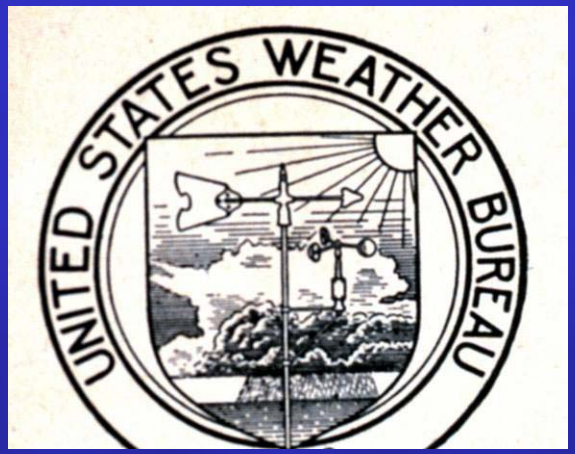
THE WEATHER OF JUNE, 1886.

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.

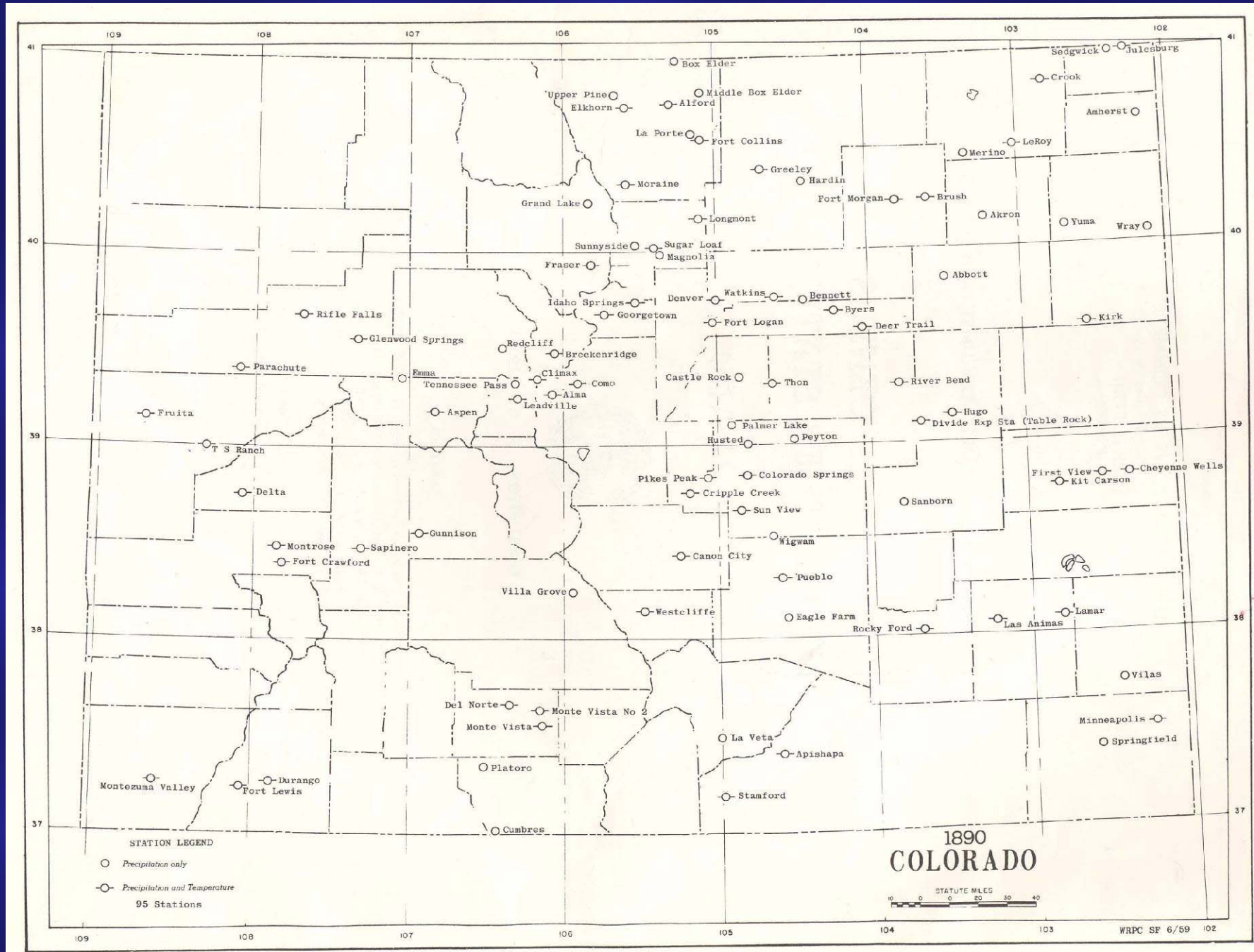
During the second period the barometer descended to the monthly minimum on the 12th, and rose during the four days following. There was no rainfall reported from the western slope, and only local and moderate showers on the eastern side. The 13th and adjacent days were remarkably clear. The temperature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



Since then, 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

National Weather Service Cooperative Network

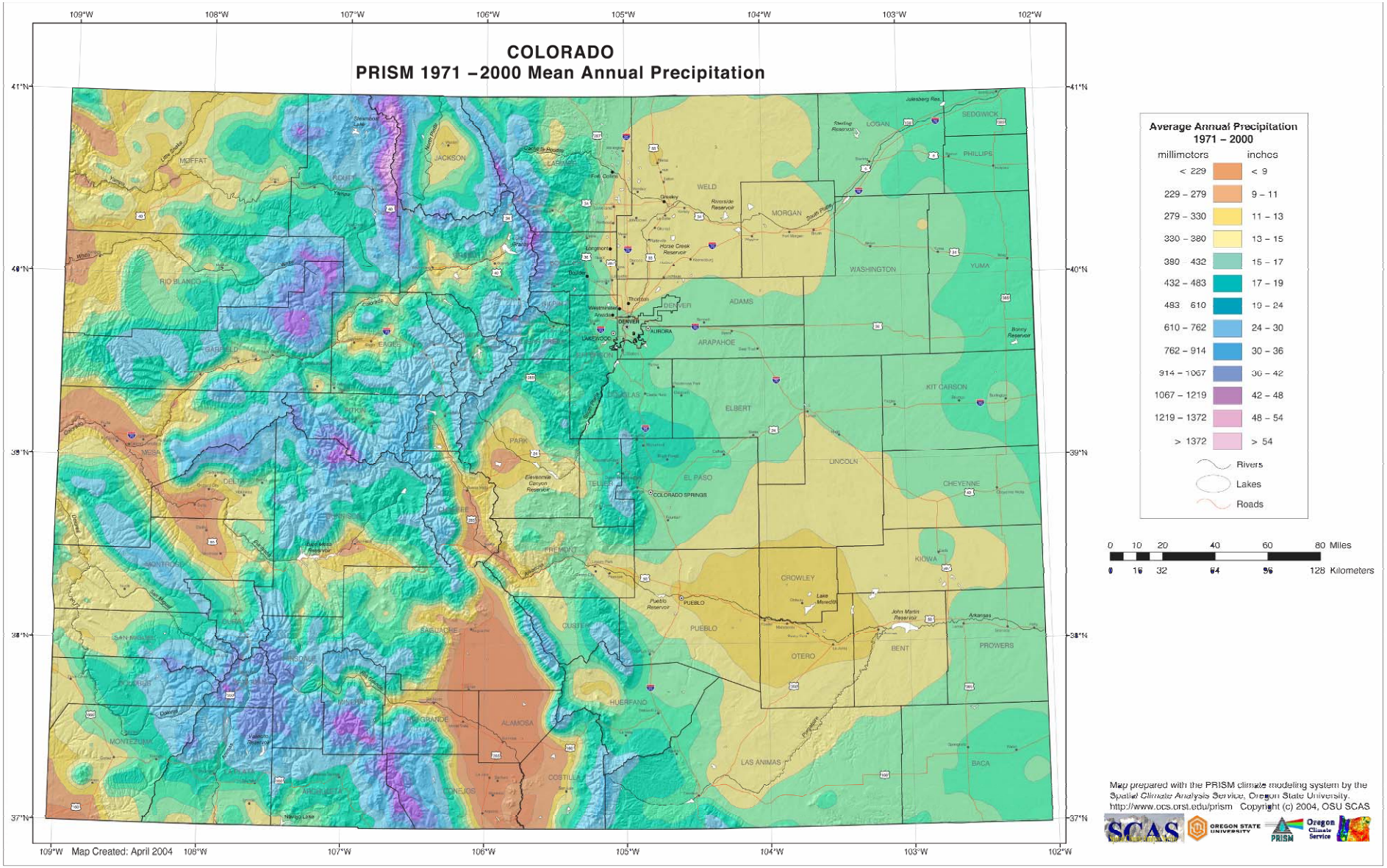
From Kelly Redmond, WRCC

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

In recent years, many other organizations have gotten involved in weather measurements

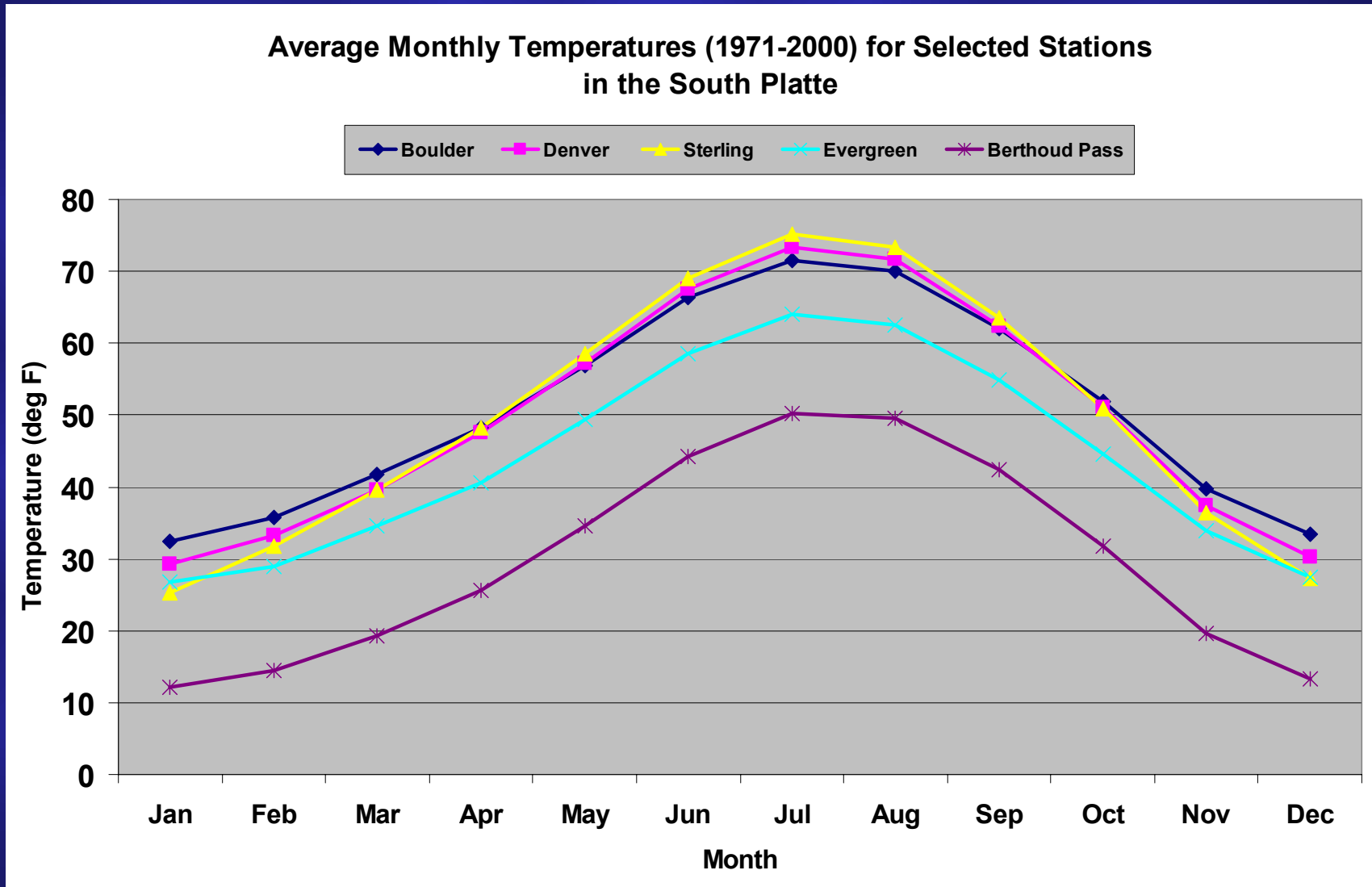
The NWS stations remain the backbone network for long-term climate monitoring

Colorado average annual precipitation map

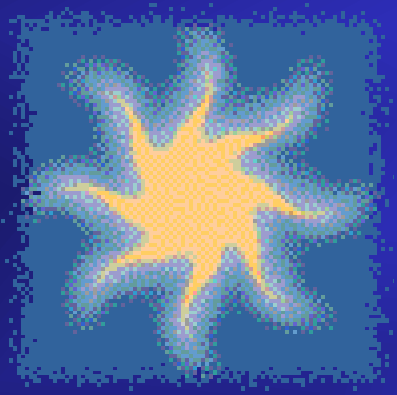


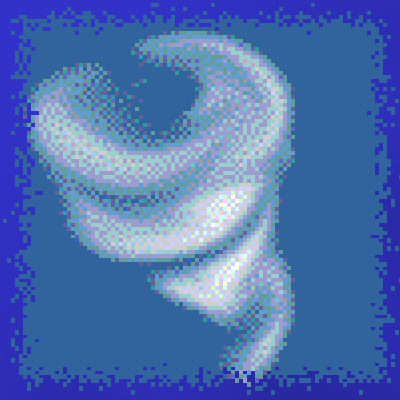
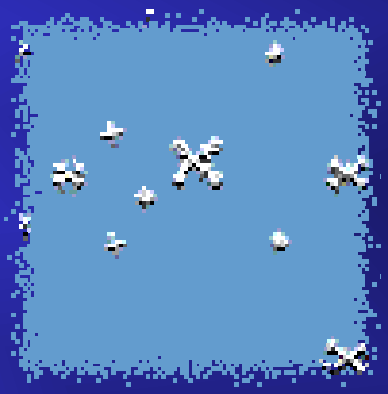
What have we learned from nearly 120 years of continuous climate monitoring in the South Platte Basin?

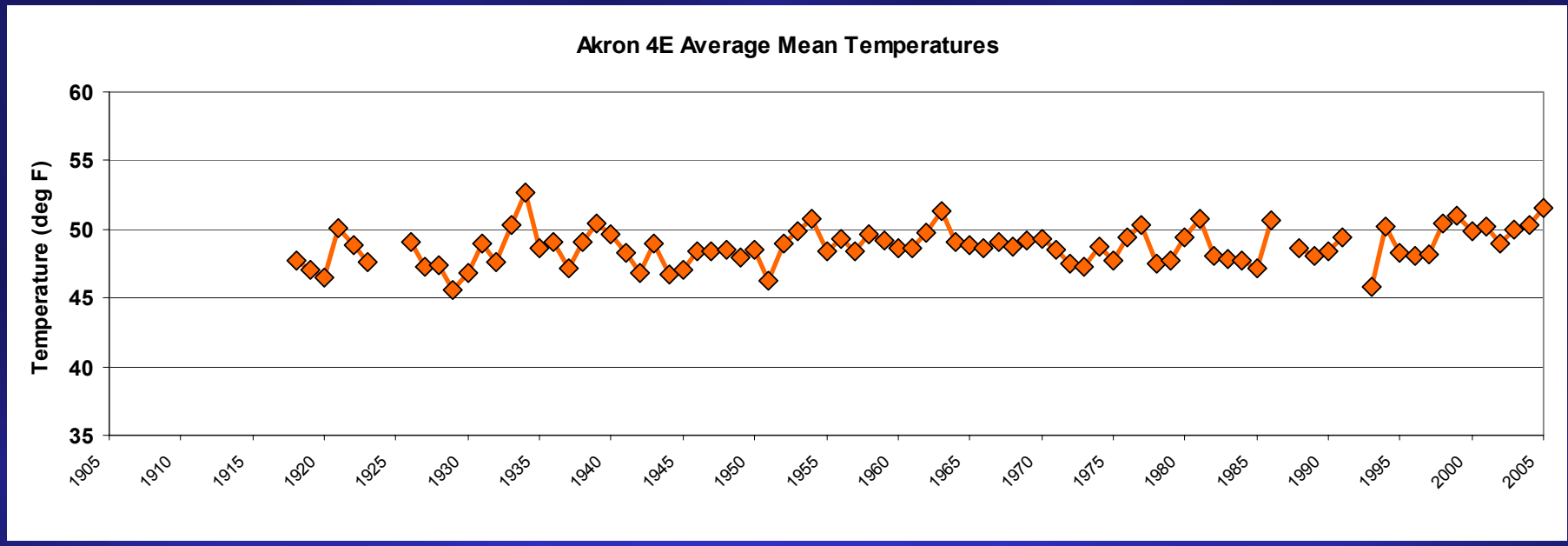
Winters are consistently colder than summers – ☺

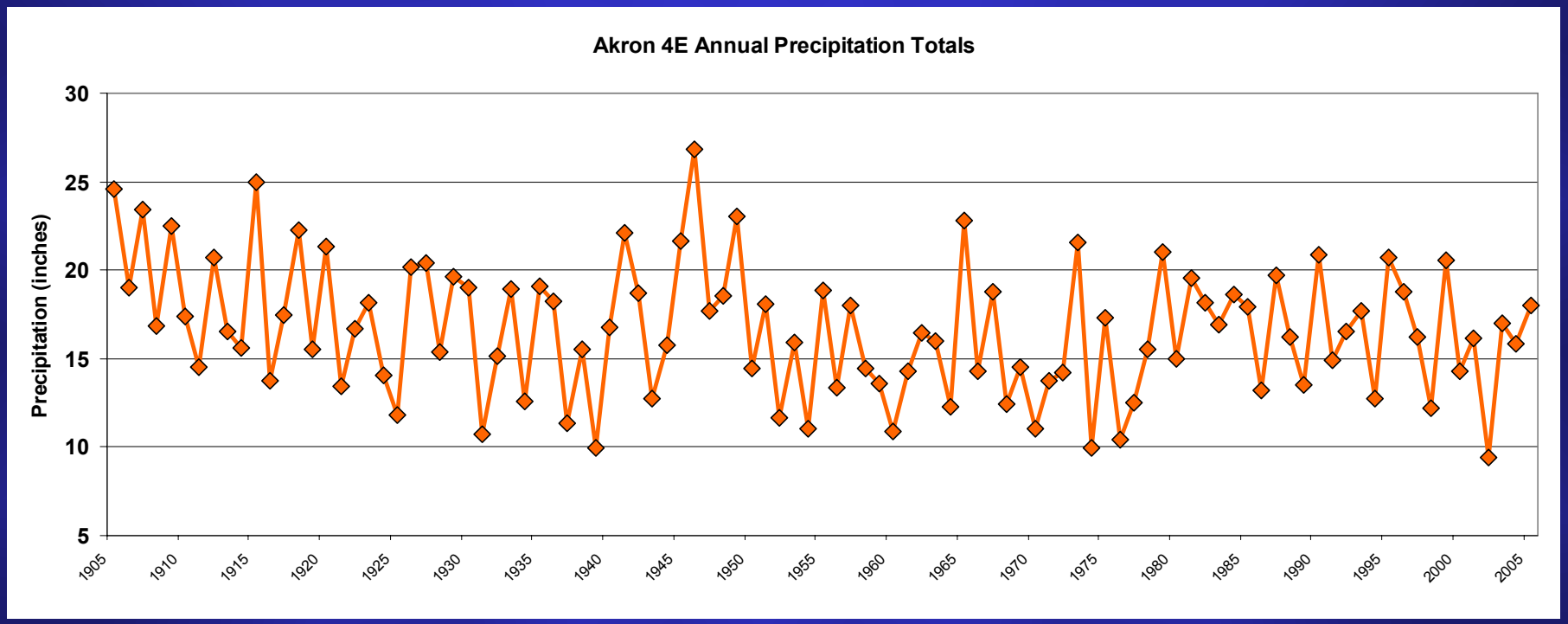


Temperatures are far more stable than precipitation. In fact most other climatic elements (humidity, wind, sunshine and cloudiness, evaporation, etc.) are much more consistent from one year to the next than precipitation.

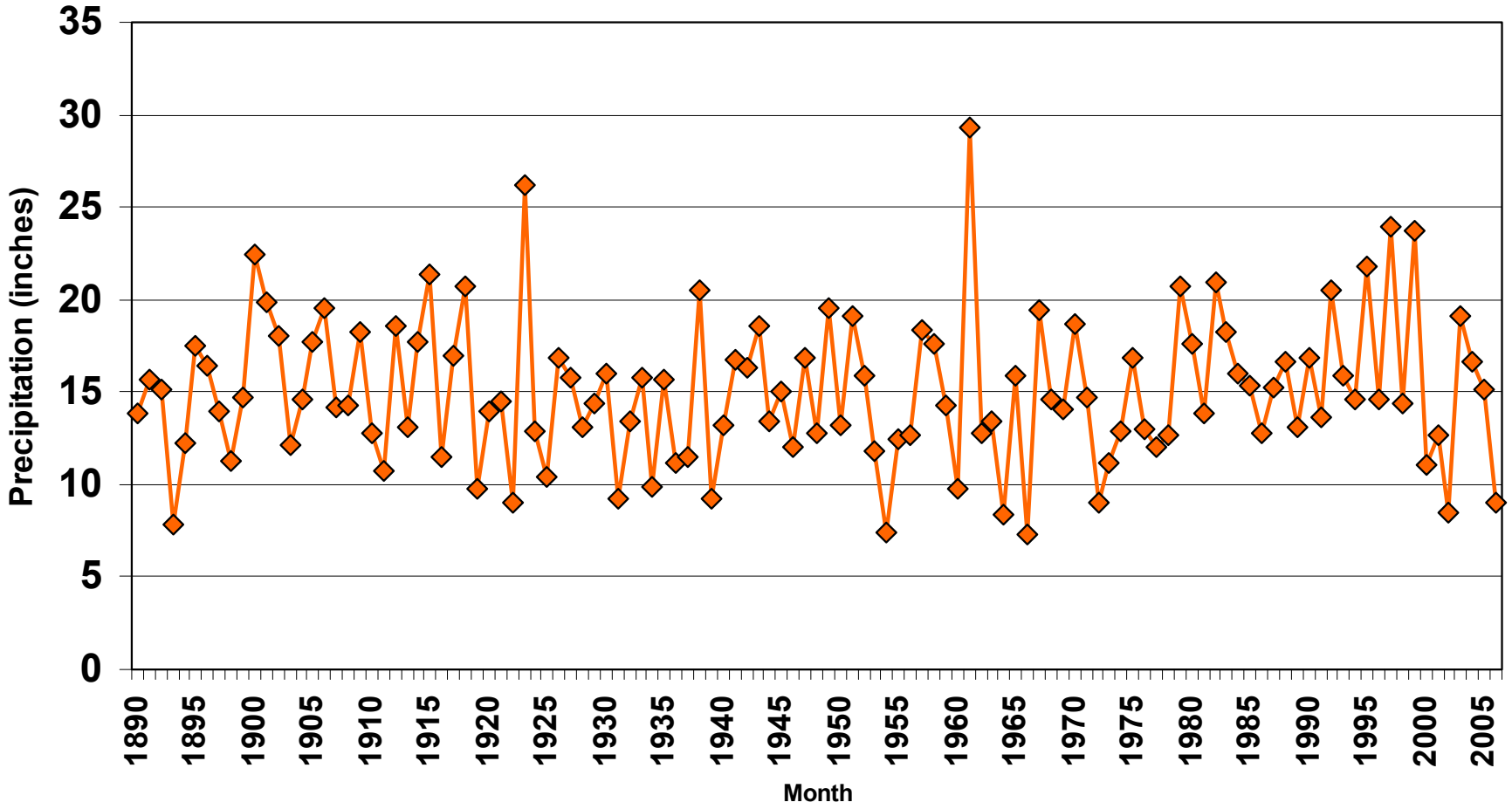



Akron 4E Average Mean Temperatures
Temperature (deg F)
60
55
50
45
40
35
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


Akron 4E Annual Precipitation Totals
Precipitation (inches)
30
25
20
15
10
5
1905
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

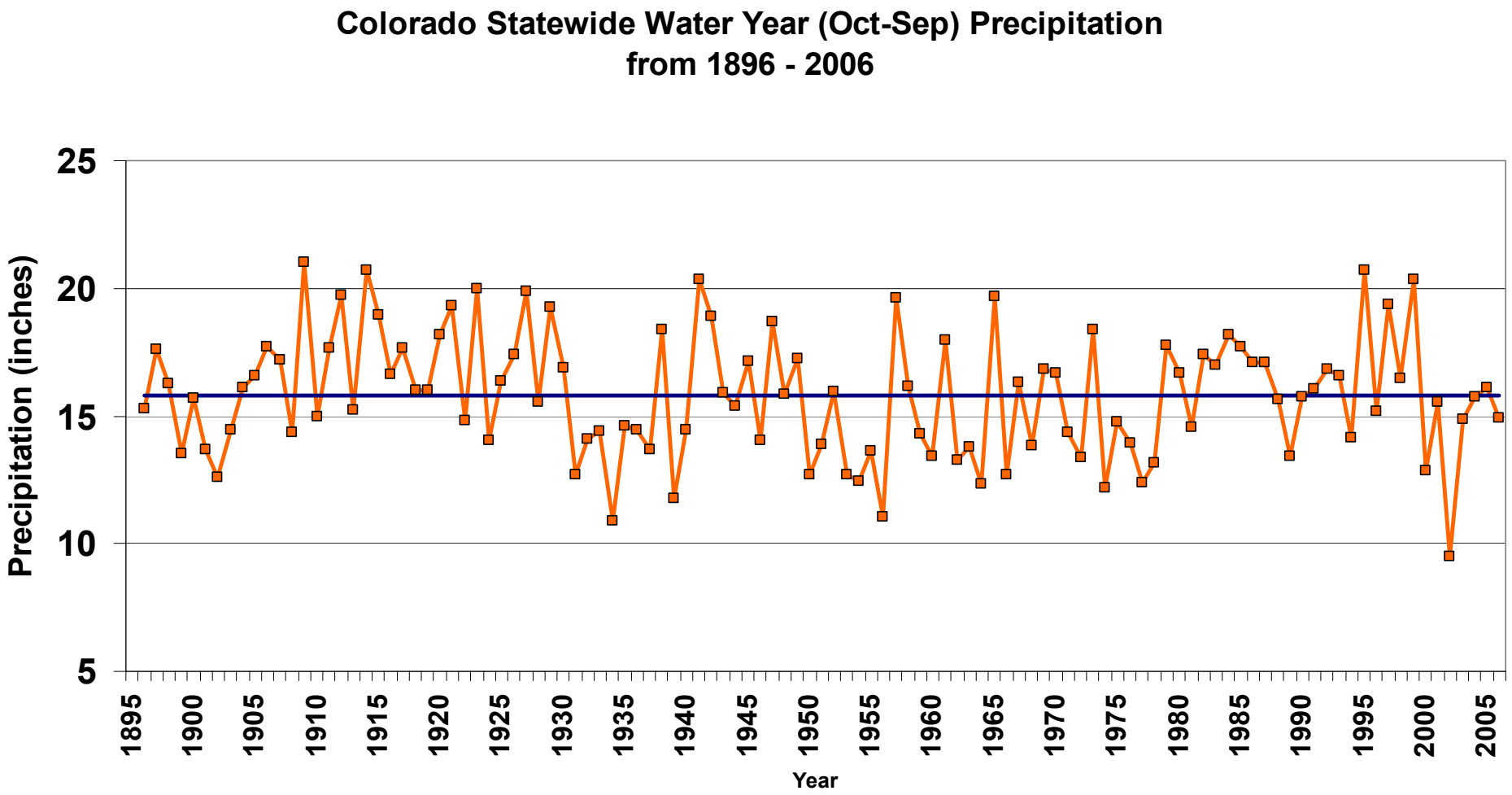
Precipitation varies by as much as 400% from a very dry year to a very wet year



Drought Visits Our Area Regularly

Photo by NRCS

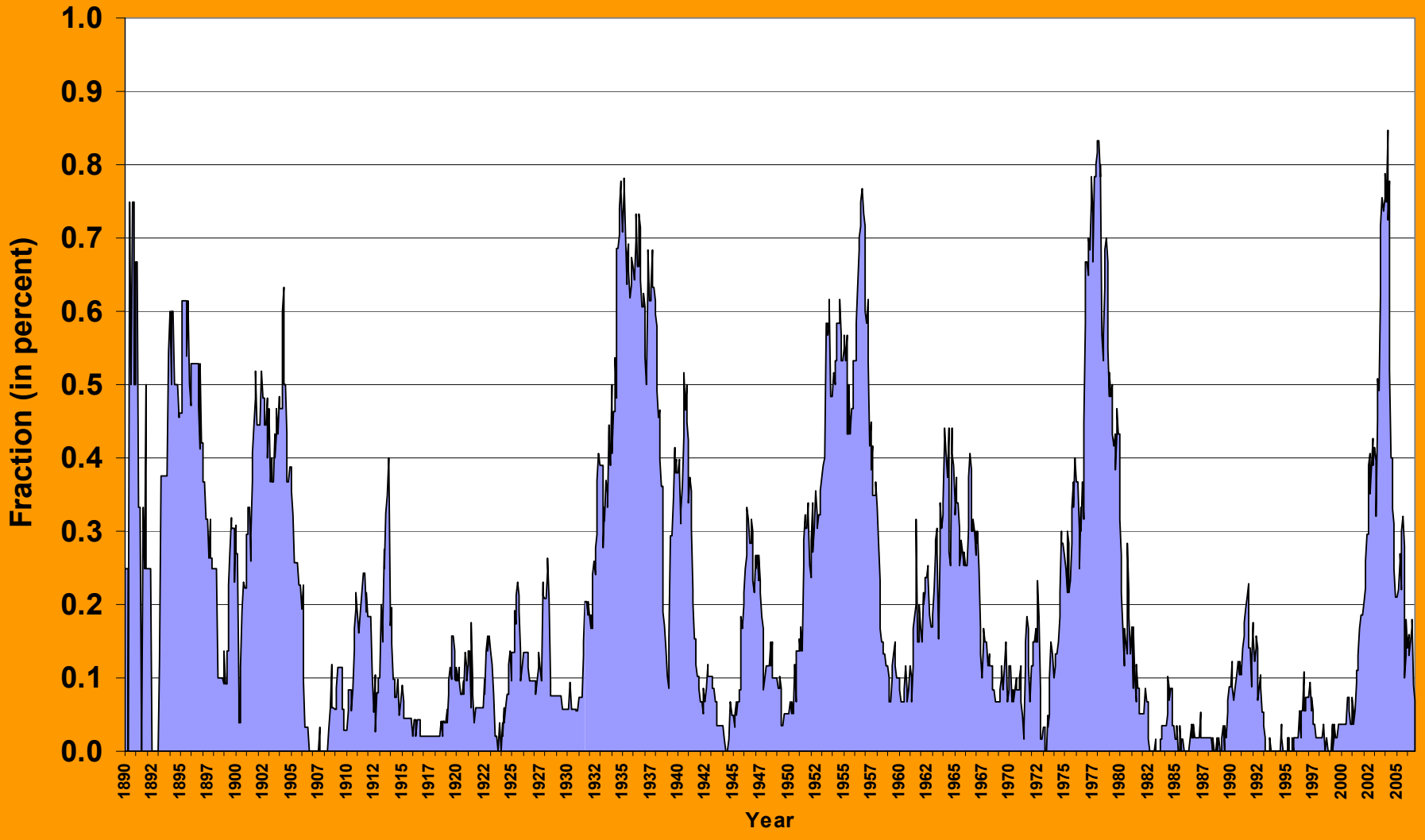
Colorado Statewide Water Year Precipitation



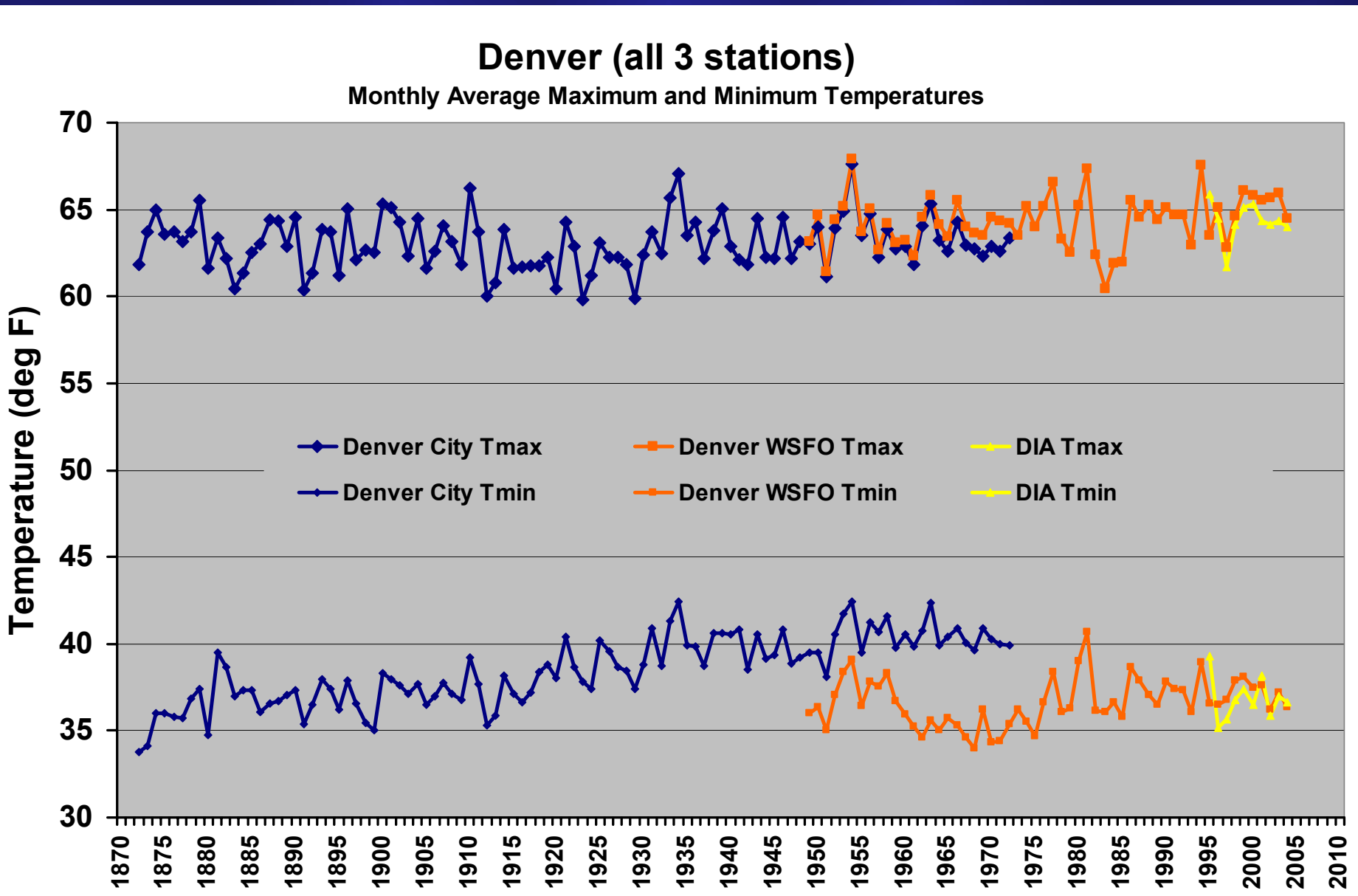
Fraction of Colorado in Drought

Based on 48 month SPI

(1890 - Sep 2006)



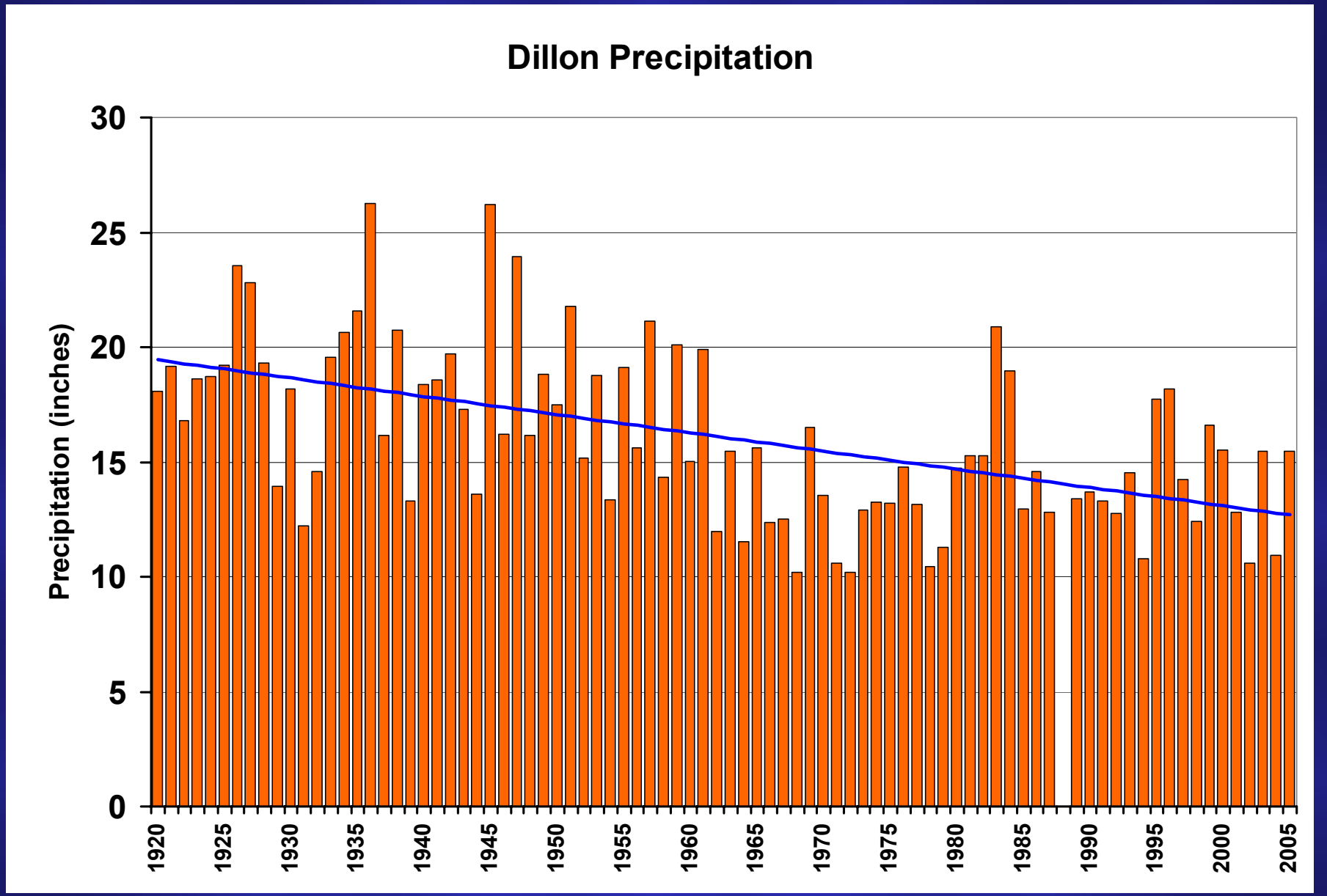
Confidently detecting climatic trends is much more challenging and difficult than determining spatial patterns, seasonal cycles, or year-to-year variations


Denver (all 3 stations)
Monthly Average Maximum and Minimum Temperatures
Temperature (deg F)
70
65
60
55
50
45
40
35
30
1870
1875
1880
1885
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
Denver City Tmax
Denver WSFO Tmax
DIA Tmax
Denver City Tmin
Denver WSFO Tmin
DIA Tmin

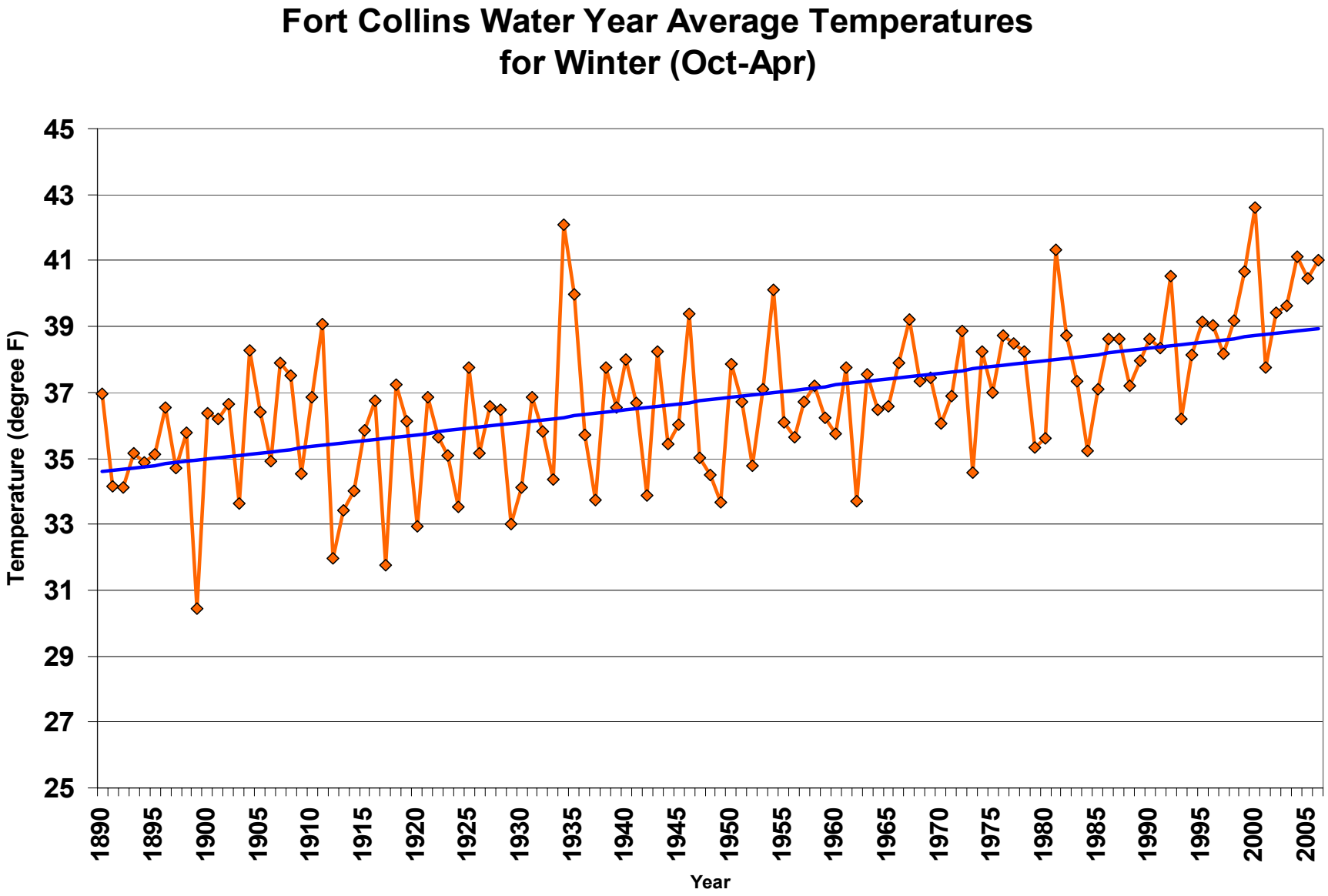
We can find many frustrating limitations to our climate records –

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

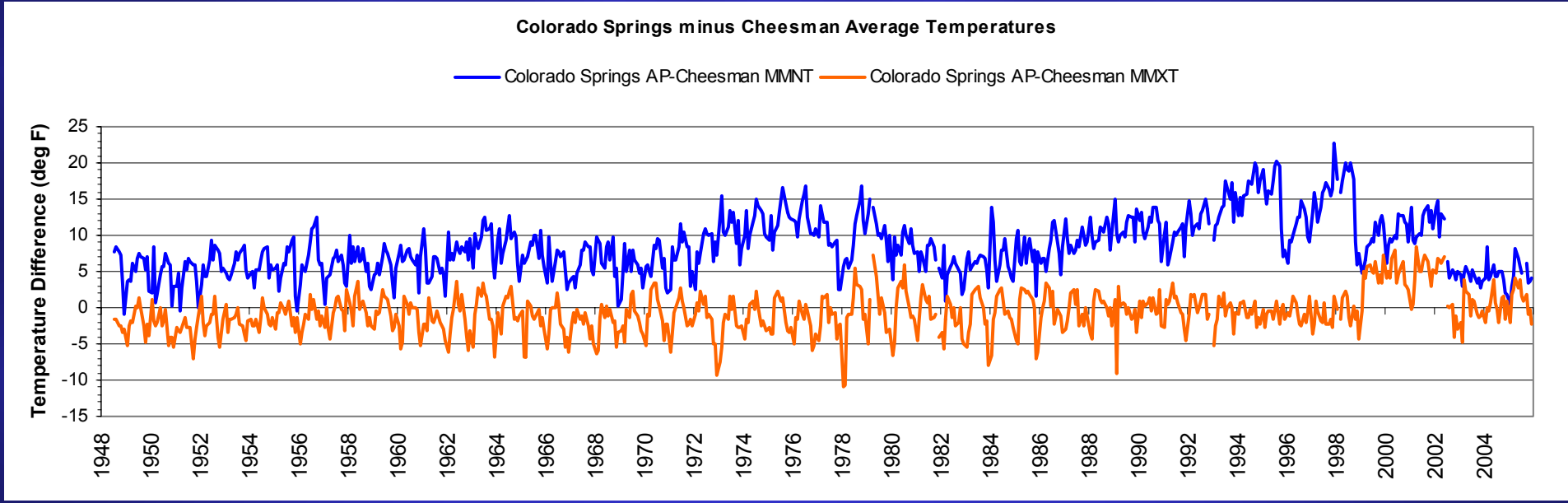
Dillon Annual Precipitation



Fort Collins Winter Temperatures

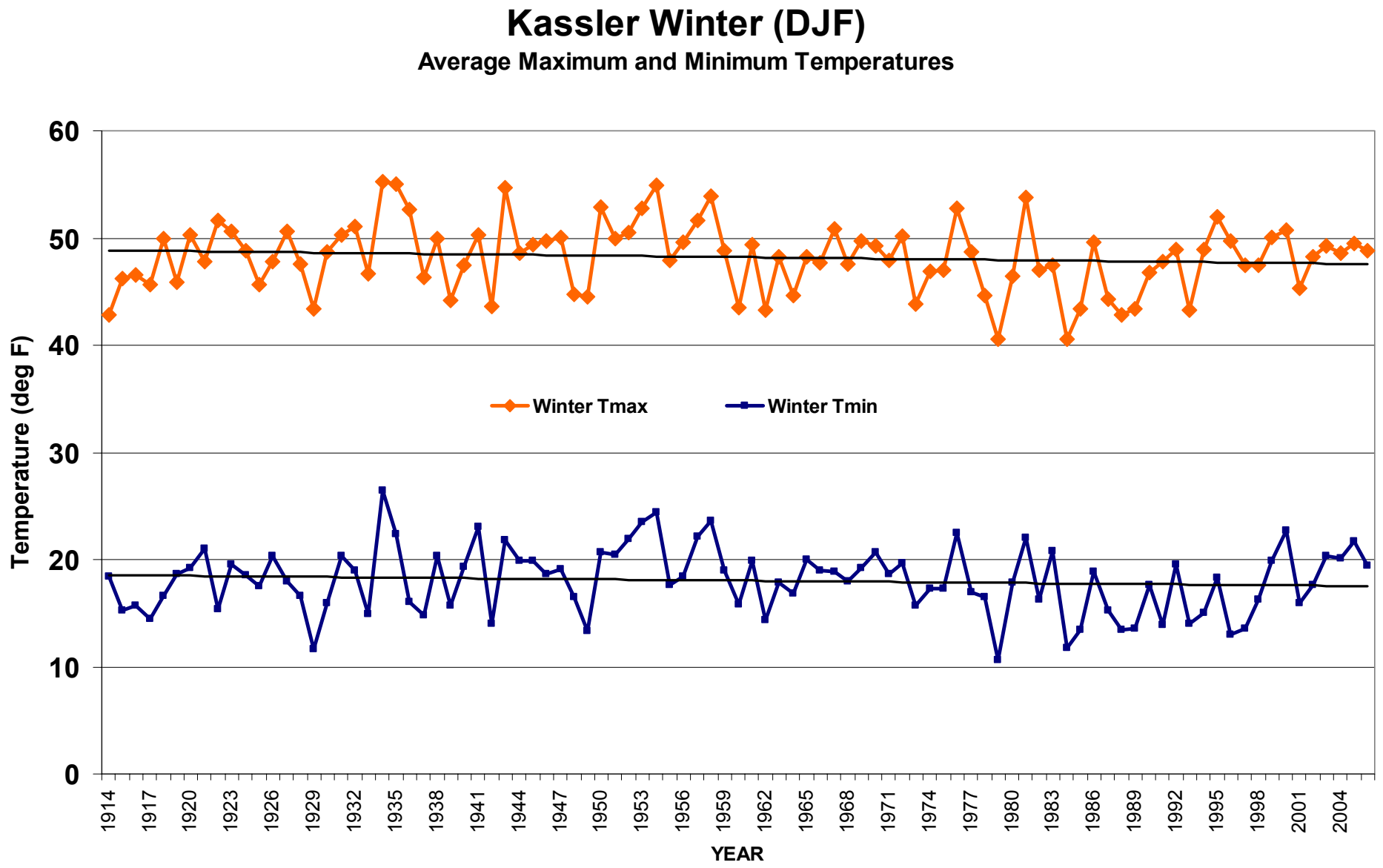


Colorado Springs minus Cheesman Temperature Difference

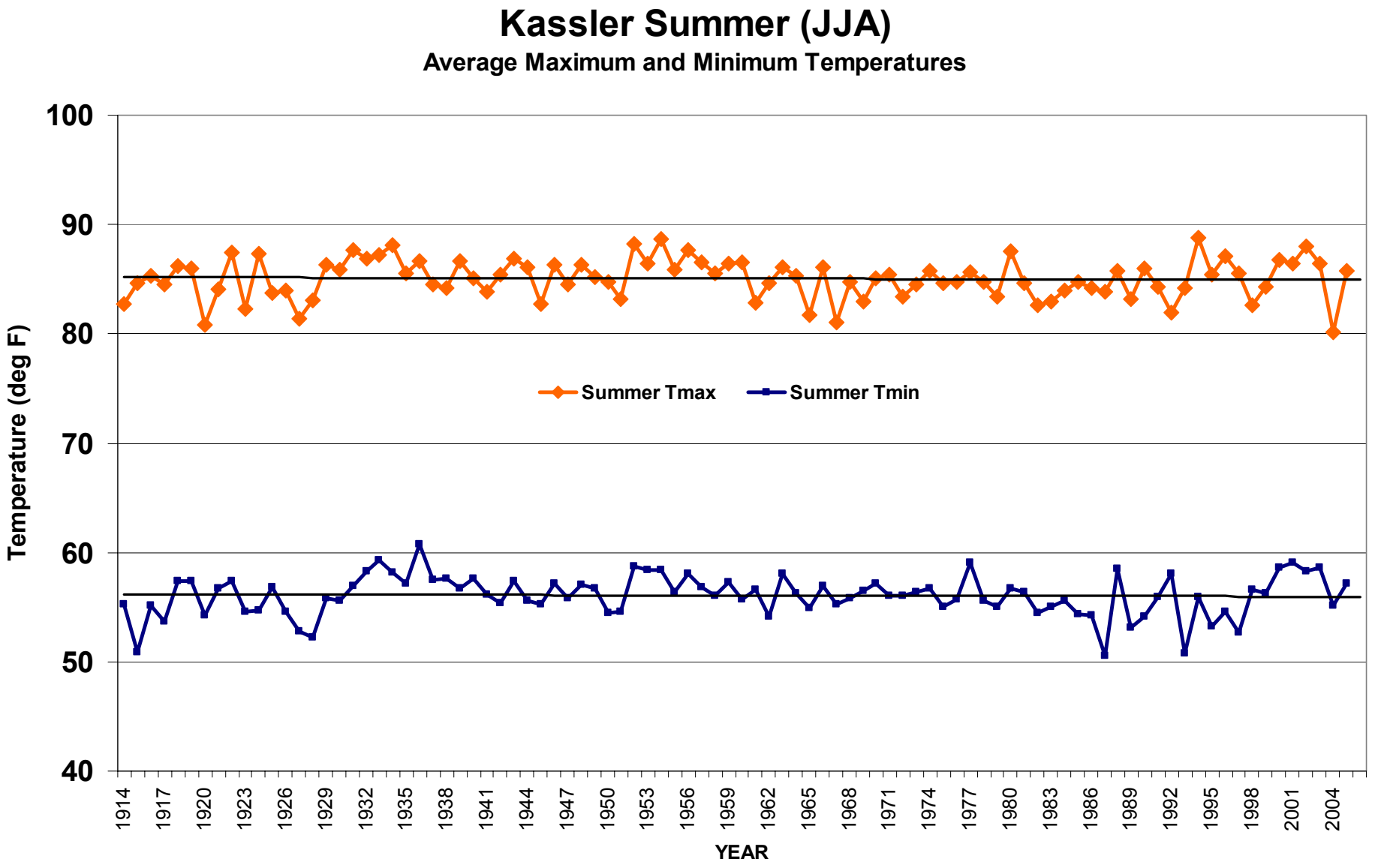


Still, our climate records are more complete, consistent, and widespread than nearly all other forms of long-term environmental monitoring (i.e. we shouldn't whine).

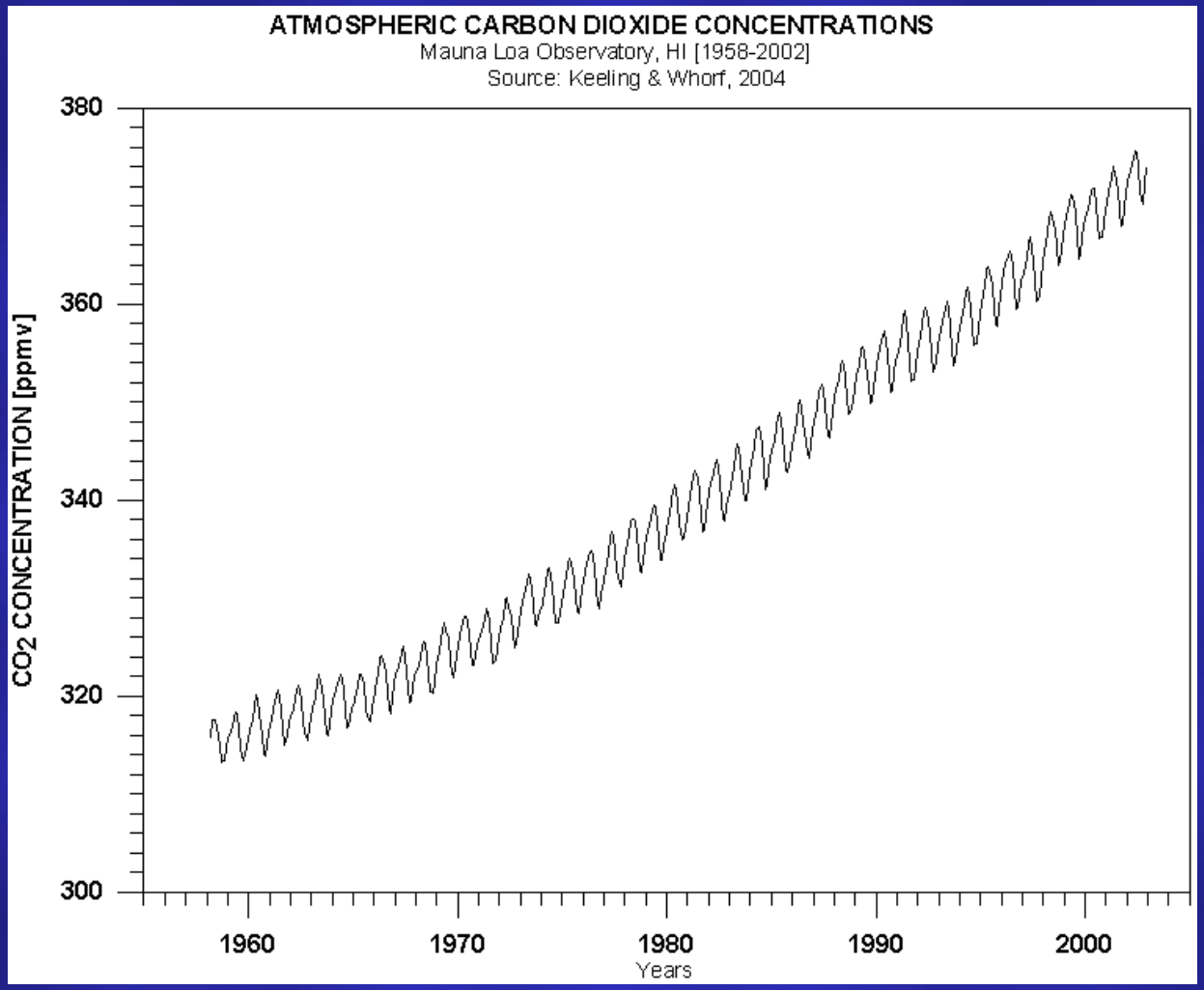
Kassler Winter Temperatures



Kassler Summer Temperatures



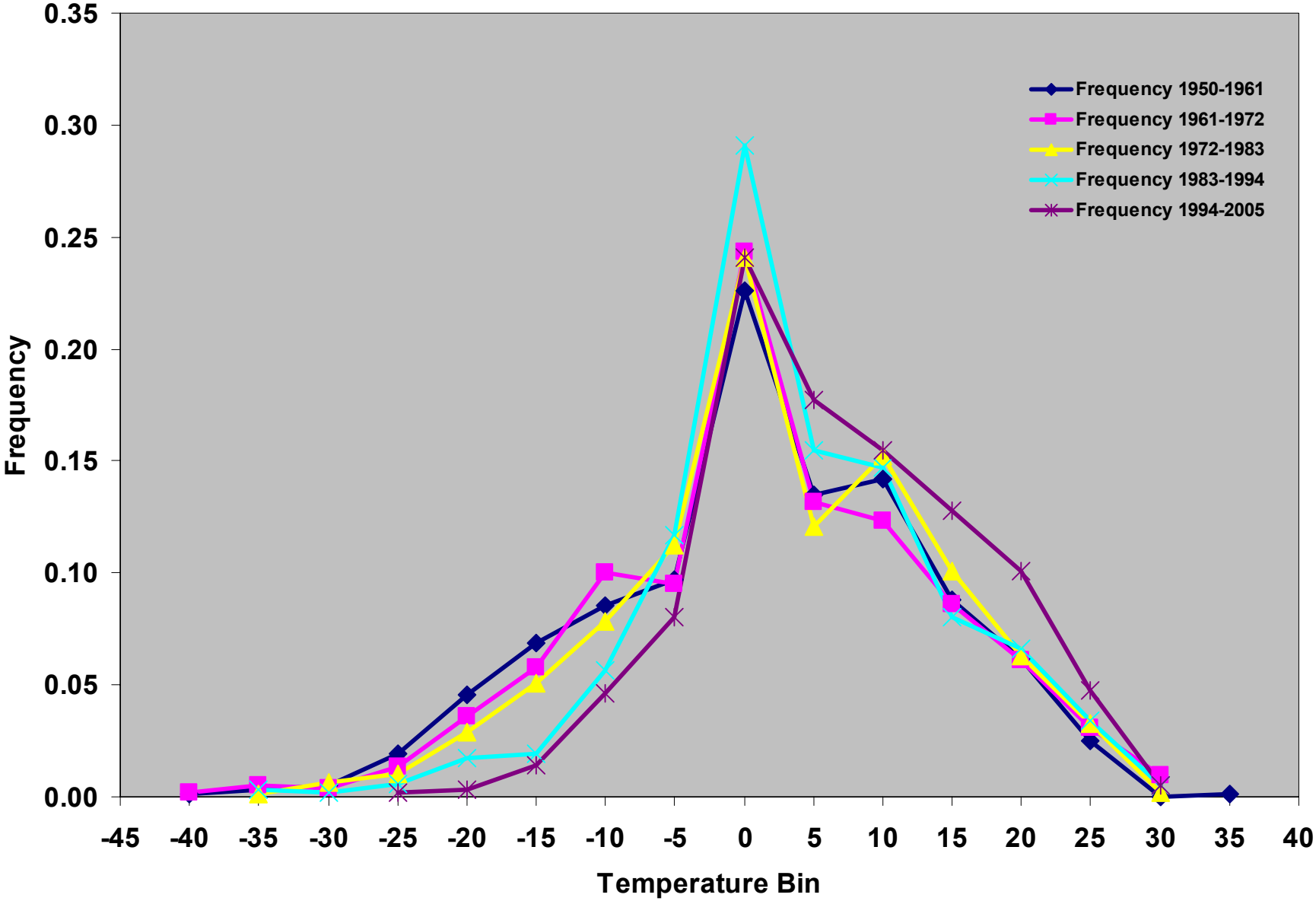
If climate is changing (man caused or otherwise), it will still be a long time before we can tell if our precipitation patterns are changing.



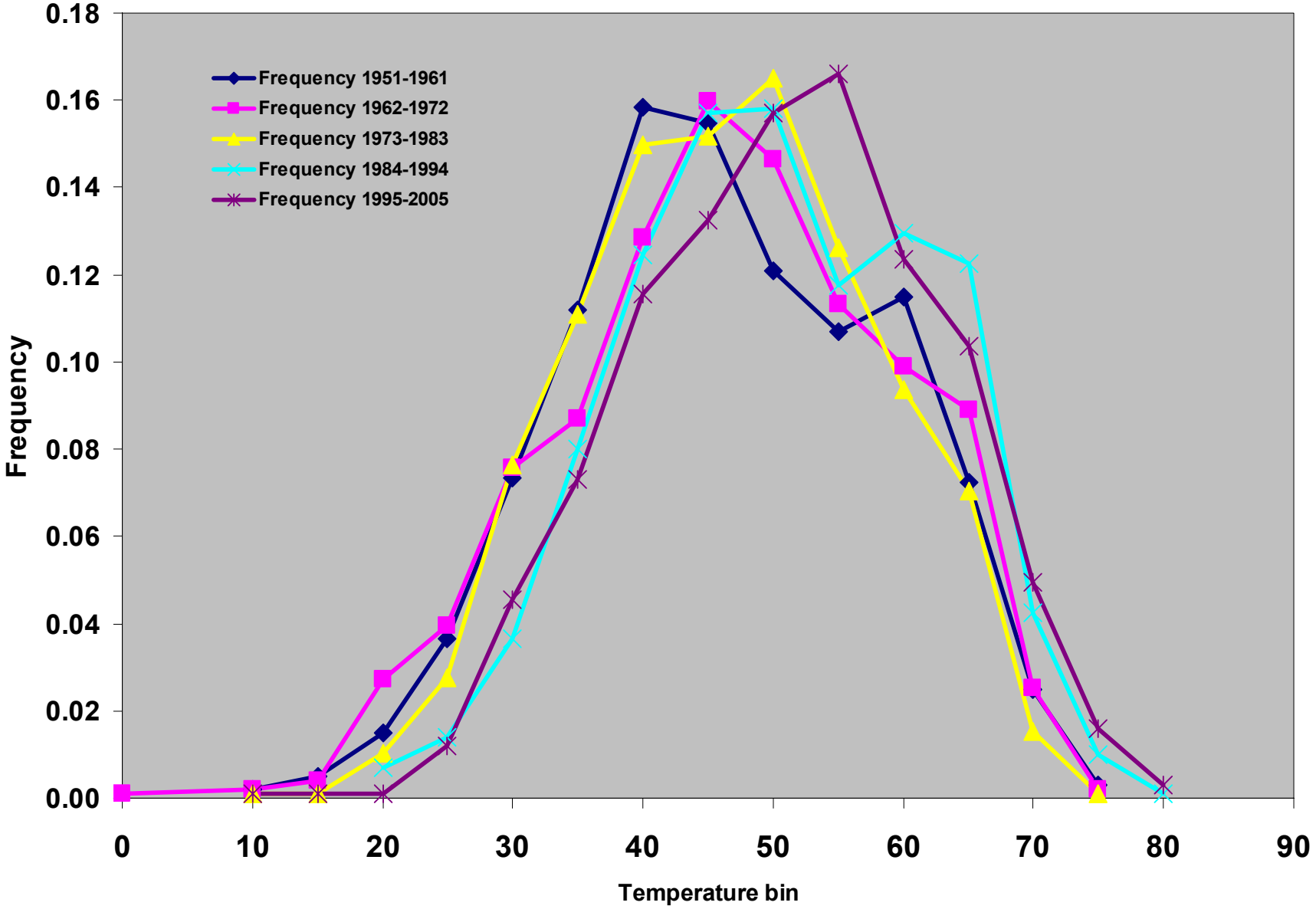
Recently, upward trends in seasonal temperatures have become noticeable in parts of Colorado

That may be significant for water users/planners whether or not precipitation is changing

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

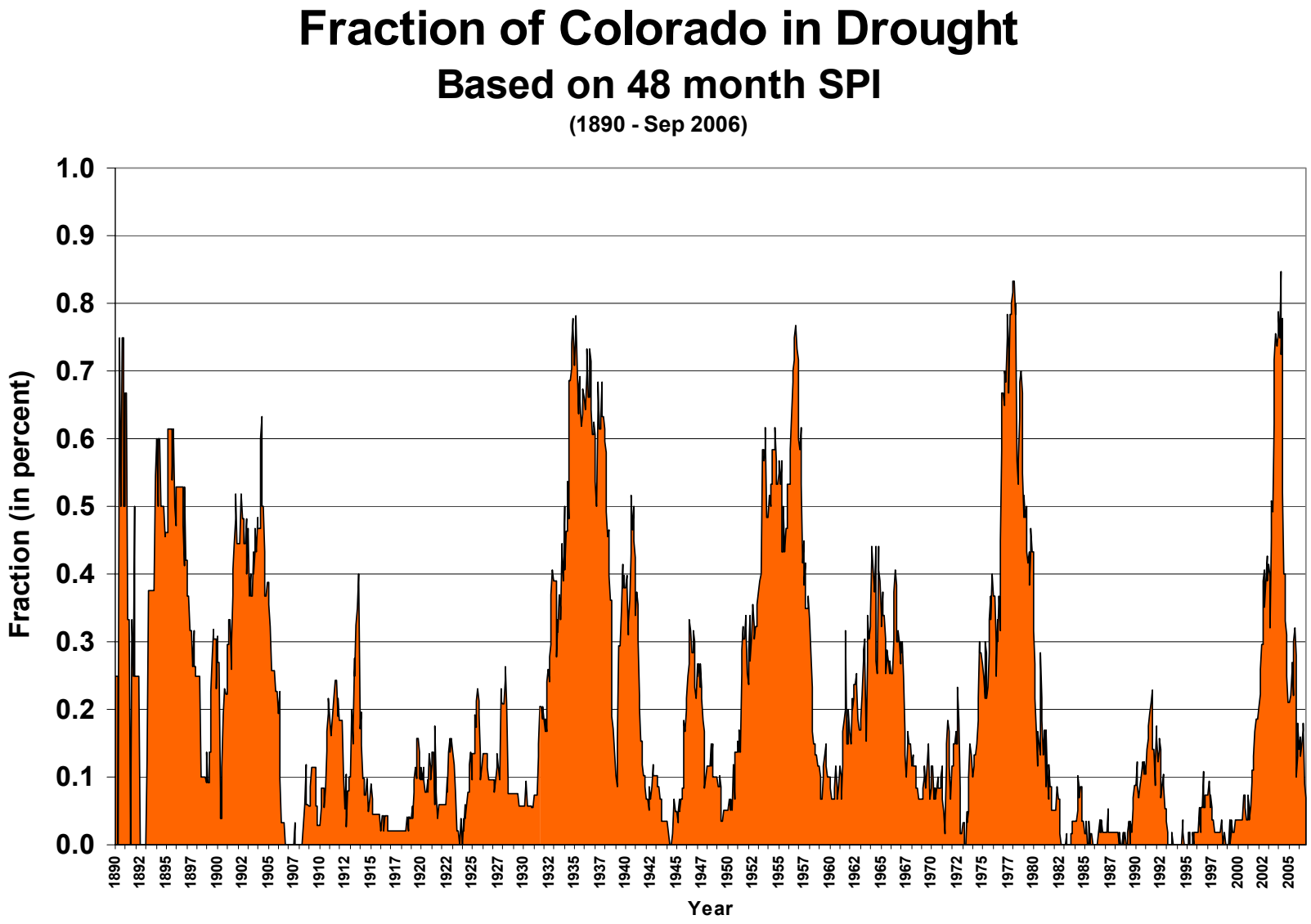


Grand Lake, CO Spring Daily Maximum Temperature Distribution (5 degree bins)

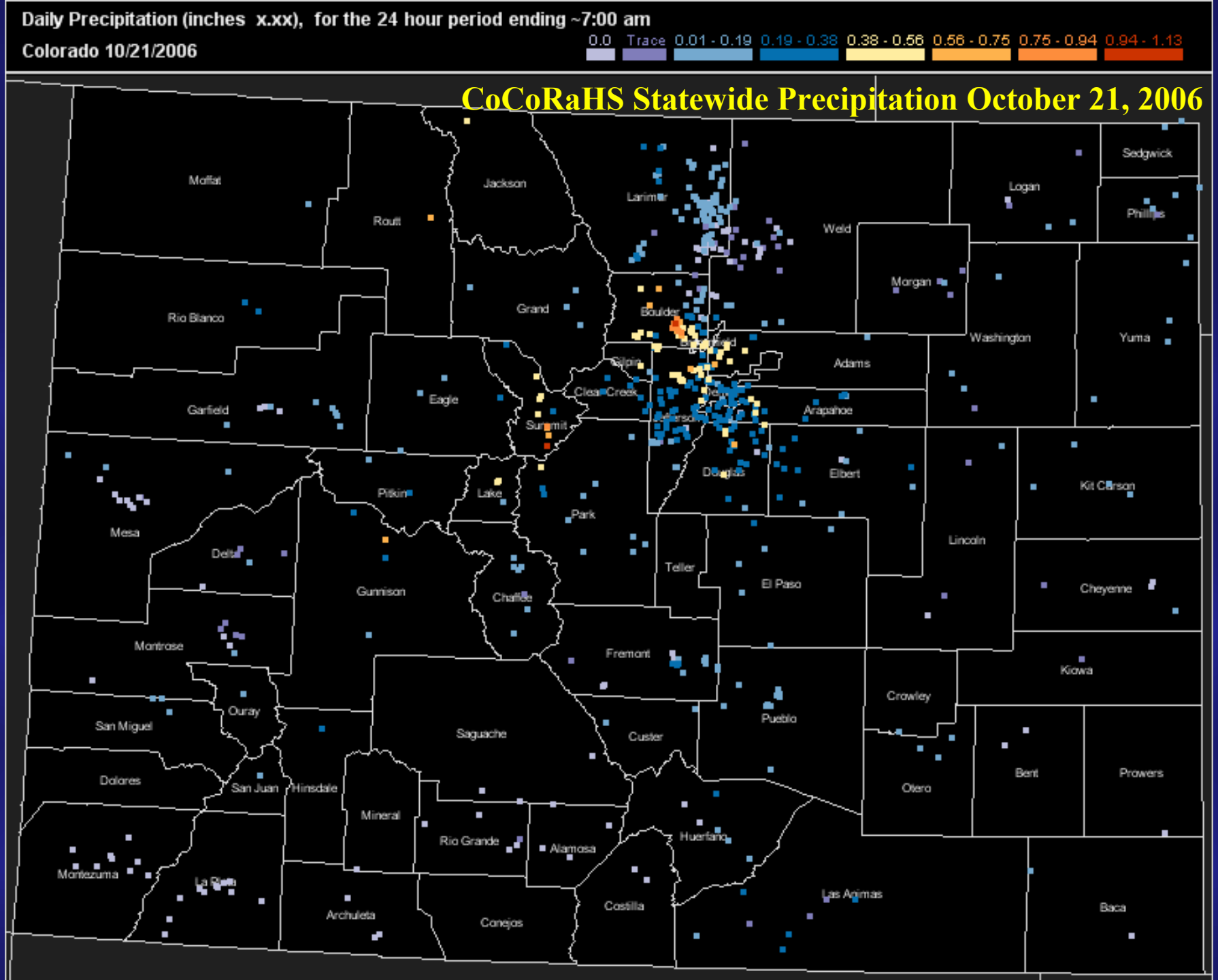


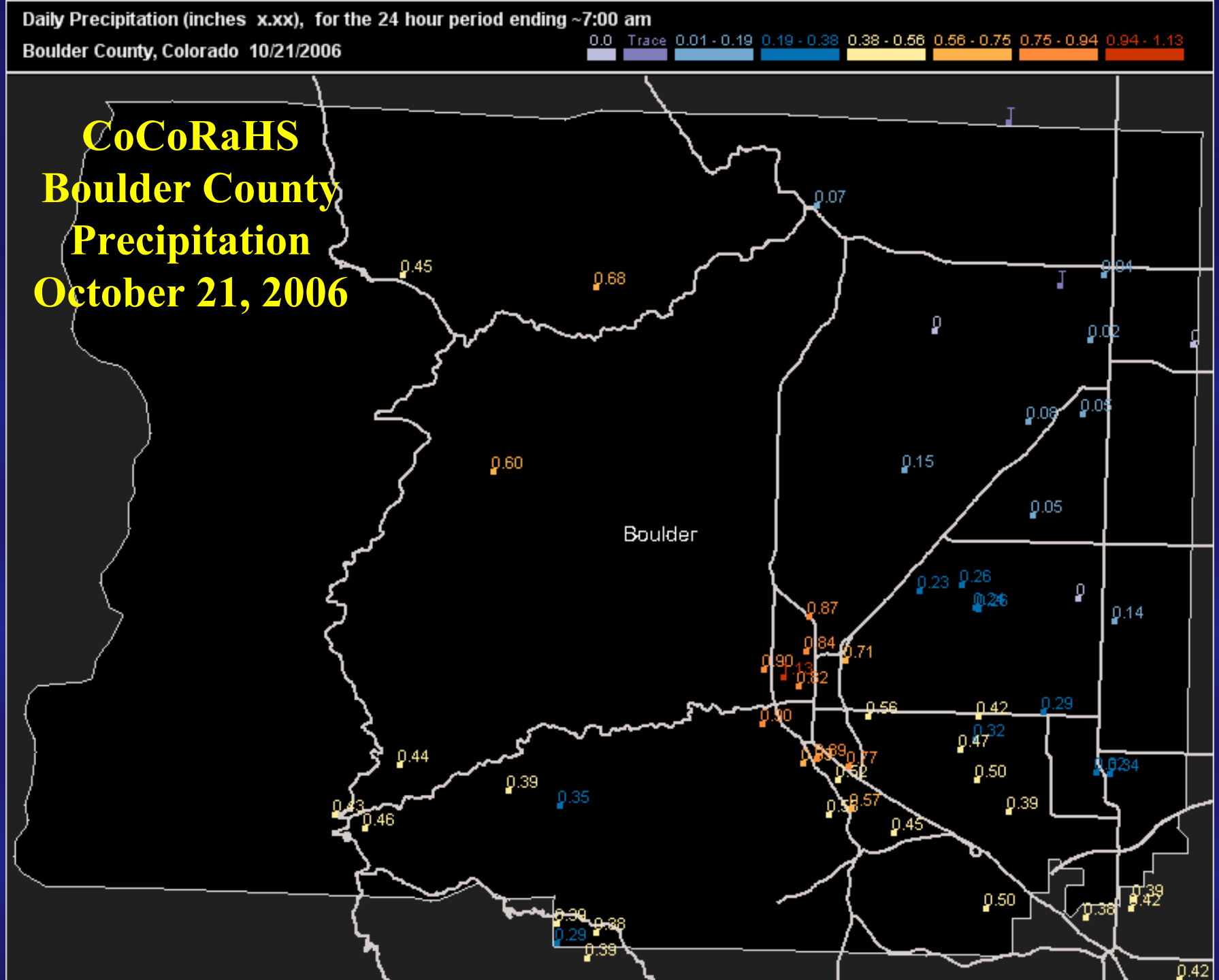
What should we do??

Always plan for drought!

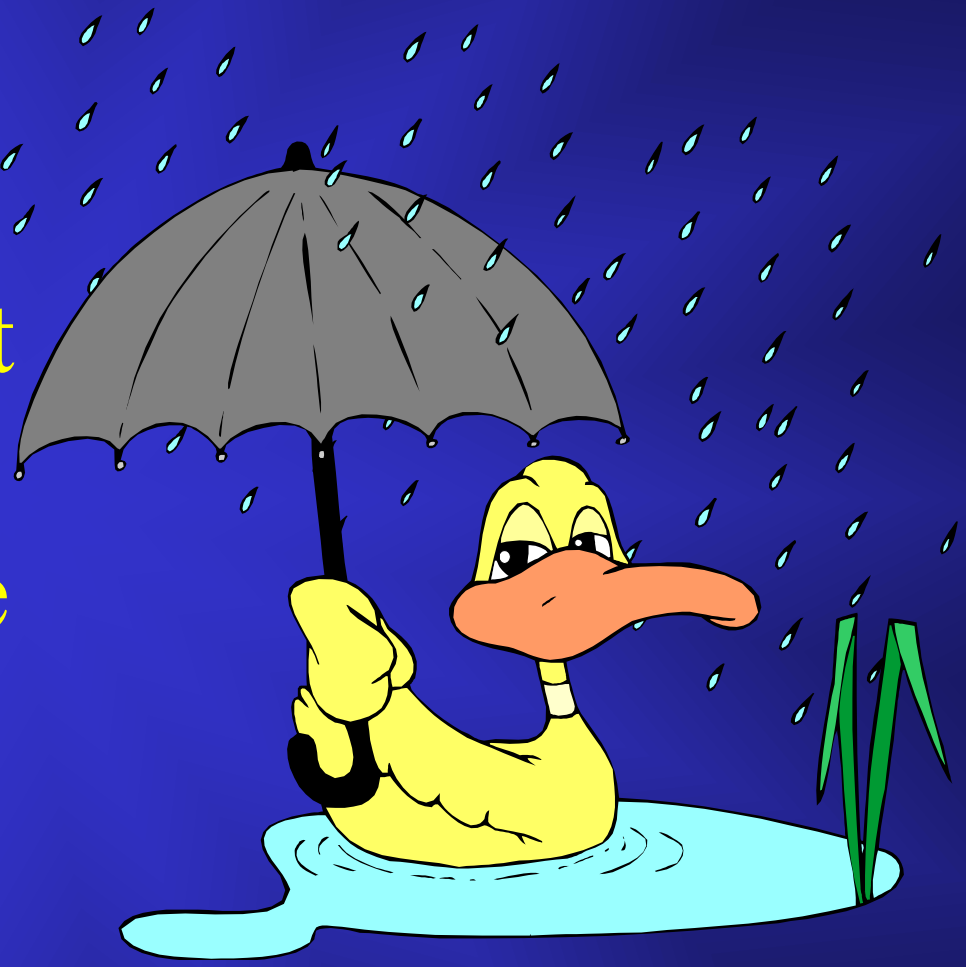


And have your rain gauge ready


Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Colorado 10/21/2006
0.0 Trace 0.01 - 0.19 0.19 - 0.38 0.38 - 0.56 0.56 - 0.75 0.75 - 0.94 0.94 - 1.13
CoCoRaHS Statewide Precipitation October 21, 2006
Moffat
Routt
Jackson
Larimer
Weld
Logan
Sedgwick
Phillips
Rio Blanco
Grand
Boulder
Morgan
Washington
Yuma
Garfield
Eagle
Summit
Clear Creek
Adams
Arapahoe
Elbert
Kit Carson
Pitkin
Lake
Park
Mesa
Delta
Gunnison
Chaffee
Teller
El Paso
Lincoln
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

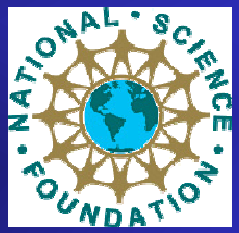

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Boulder County, Colorado 10/21/2006
0.0 Trace 0.01 - 0.19 0.19 - 0.38 0.38 - 0.56 0.56 - 0.75 0.75 - 0.94 0.94 - 1.13
CoCoRaHS
Boulder County
Precipitation
October 21, 2006
Boulder
0.07
0.45
0.68
0.60
0.15
0.05
0.23
0.26
0.87
0.84
0.71
0.90
0.82
0.56
0.42
0.29
0.32
0.47
0.50
0.39
0.44
0.39
0.35
0.46
0.57
0.45
0.50
0.38
0.29
0.42

If you are a chronic weather watcher or water worrier (or warrior) and you aren't already a part of CoCoRaHS, please see me at the break or at lunch.



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.

Colorado Climate Center

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu

Colorado State University

Knowledge to Go Places

Colorado Climate Center