

Understanding Our Climate Through Precipitation Measurements

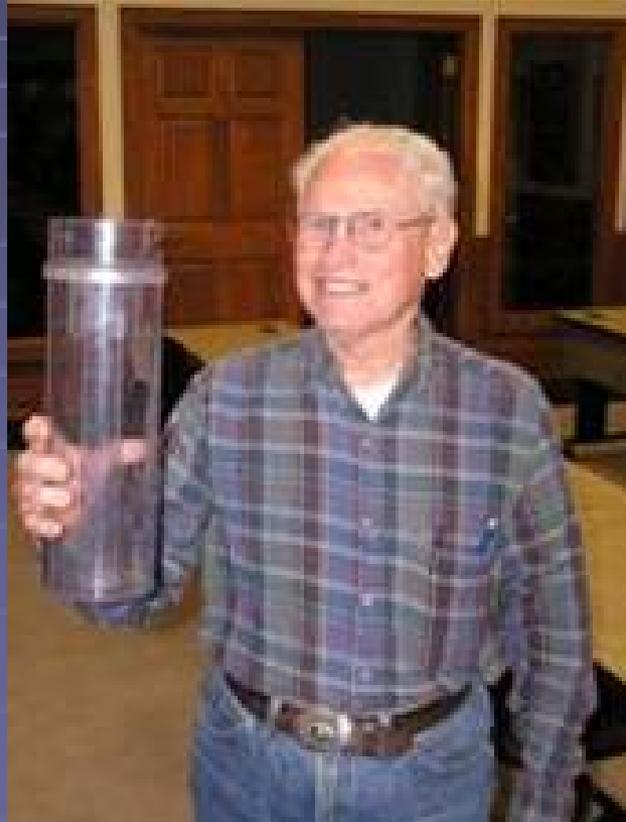


Nolan Doesken
Colorado State Climatologist

Presented to:
CU Hydrosociences Symposium
1 April 2010

Presentation assisted by
Wendy Ryan, CCC

- It may come as a surprise, but after nearly 200 years of measuring precipitation, we are still trying to figure out how.



National Weather Service 8" Standard Gauge (since 1880s)



Old style – copper or brass



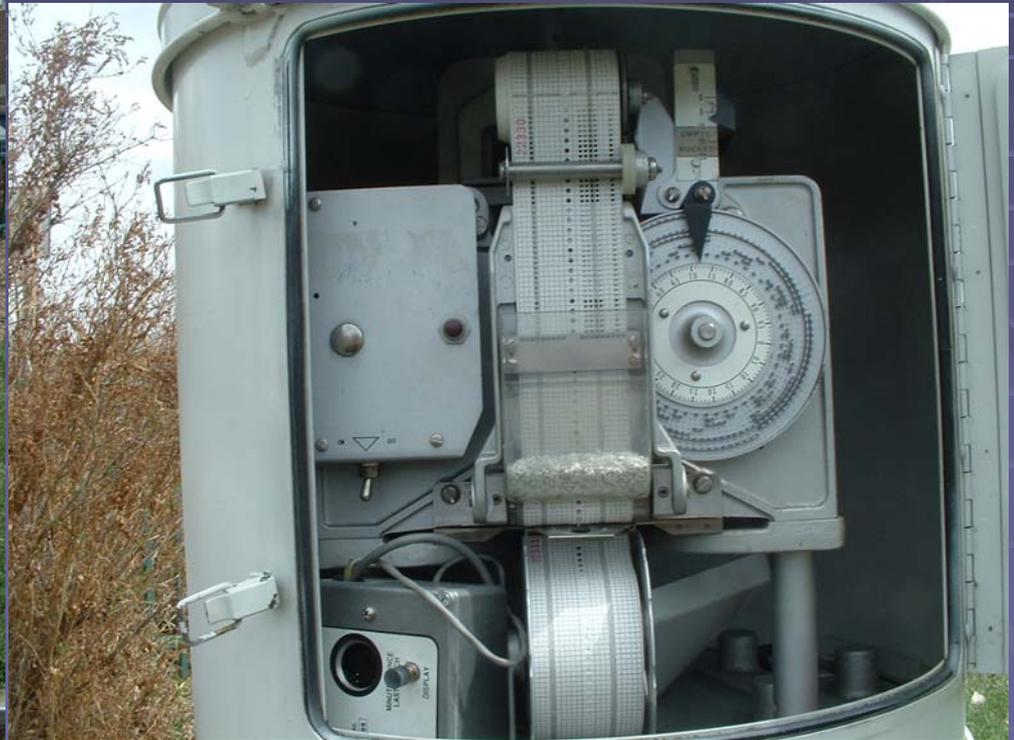
New style -- stainless and plastic

NWS Universal Weighing Bucket Gage



– long time workhorse gauge for measuring rainfall rates

NWS Fischer-Porter Gauge



Current NWS recording gauge for climatological measurement of rainfall rates

ASOS Heated Tipping Bucket

Used at many U.S. major airports 1990s - ~2006
Gauge is inferior for use in snow



NWS Photo

ASOS AWPG with Tretyakov Shield

Replace ASOS
Heating tipping
Bucket gauge
In 2000s

Better for snow,
But still has trouble
In high wind
conditions



CARE Test Facility,
Egbert, Ontario

Geonor Gage

Uses “vibrating Wire” to determine Weight and amount Of precipitation

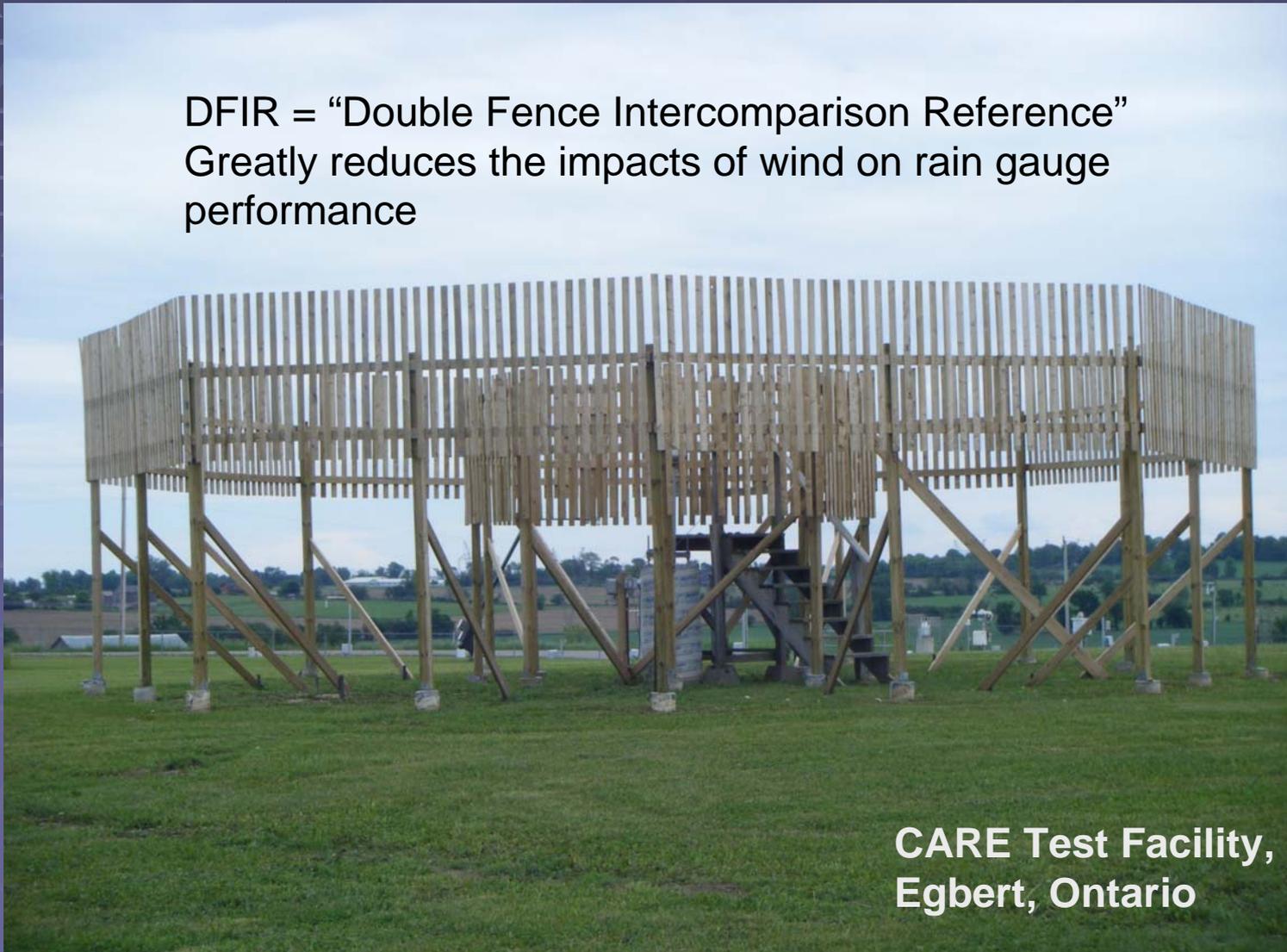
Has become Popular in 2000s



CARE Test Facility,
Egbert, Ontario

Climate Reference Network Geonor in Full DFIR

DFIR = “Double Fence Intercomparison Reference”
Greatly reduces the impacts of wind on rain gauge performance



**CARE Test Facility,
Egbert, Ontario**

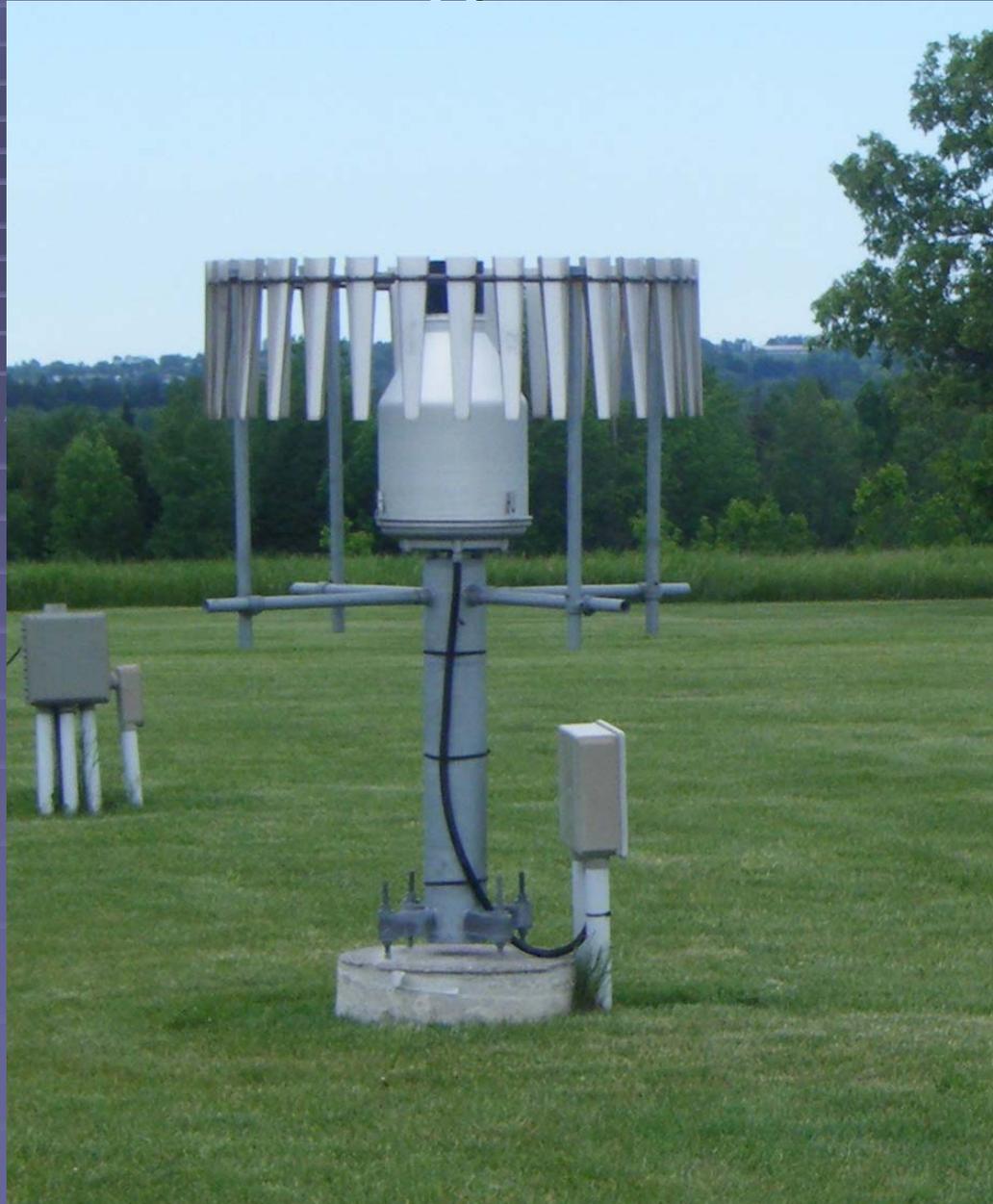
Small DFIR

Used in the U.S. Climate Reference Network to improve gauge catch efficiency. Not as large as the full DFIR but still works very well.



**CARE Test Facility,
Egbert, Ontario**

Geonor Single Alter Shield

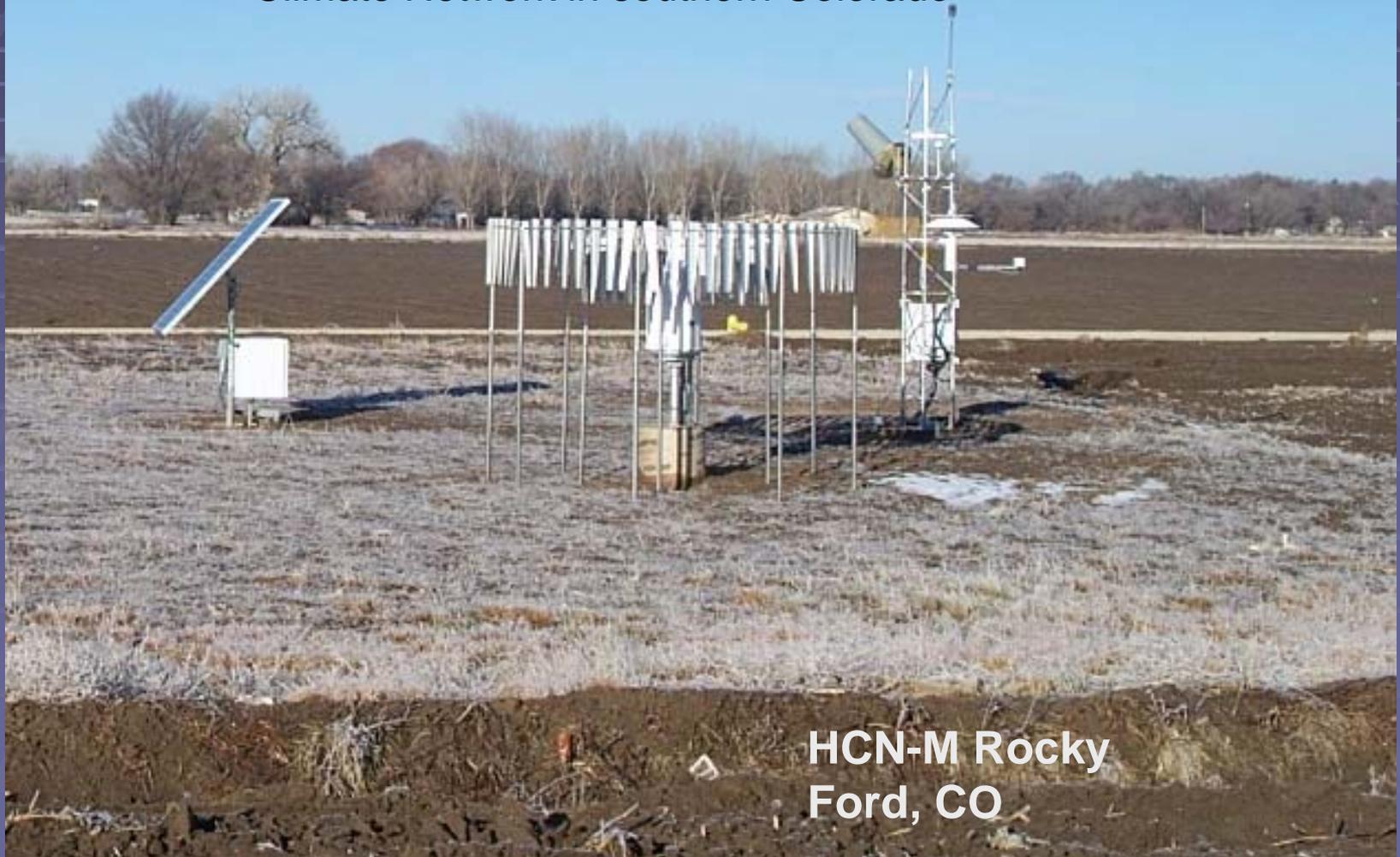


The Alter shield shown here has been in common use in the U.S. but only modestly improves gauge catch.

**CARE Test Facility,
Egbert, Ontario**

Geonor HCN-M in Double Alter Shield

Weather station recently installed for NOAA Historical Climate Network in southern Colorado



**HCN-M Rocky
Ford, CO**

Canadian Manual Gauge in Nipher Shield

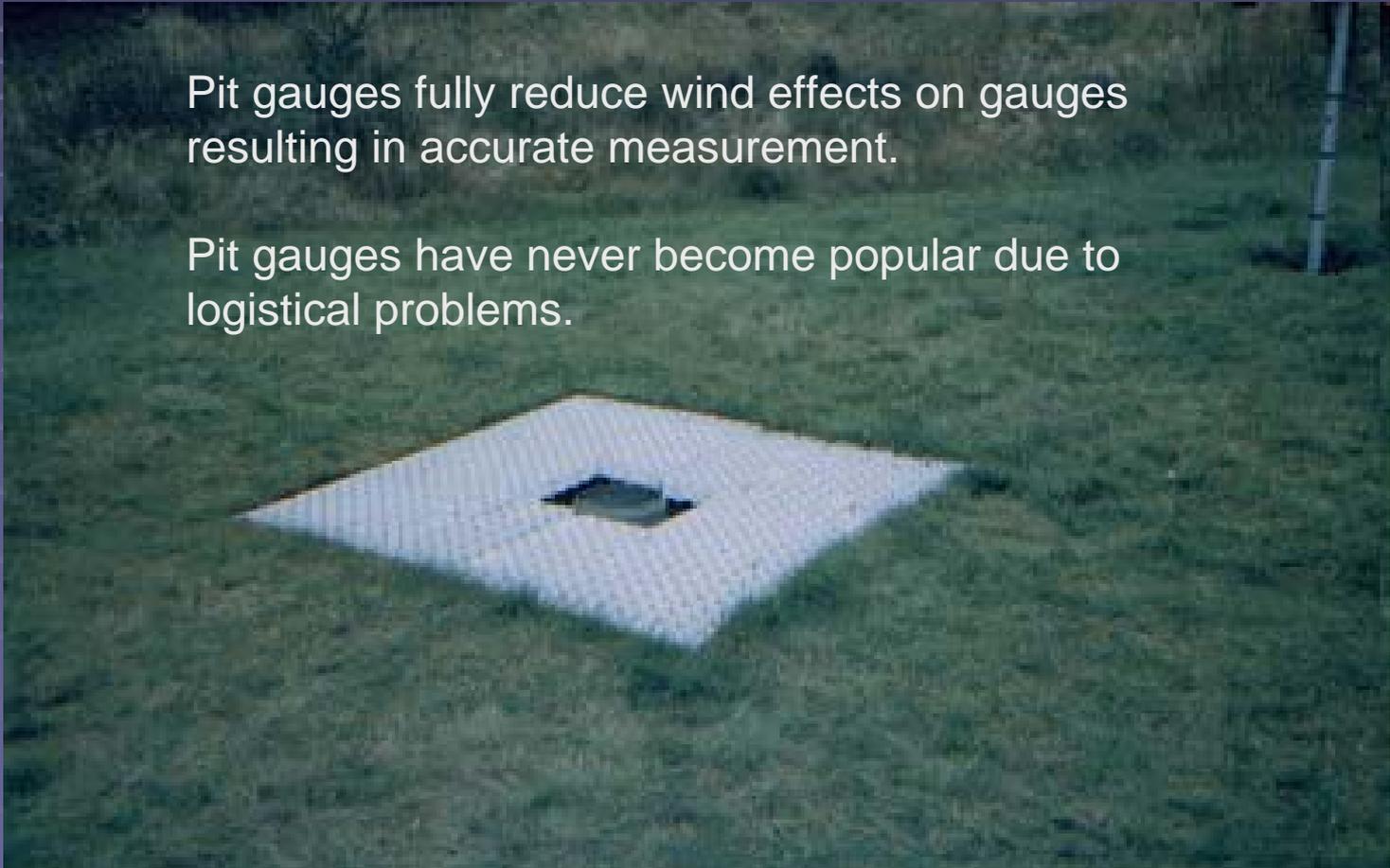


CARE Test Facility,
Egbert, Ontario

Pit Gauge

Pit gauges fully reduce wind effects on gauges resulting in accurate measurement.

Pit gauges have never become popular due to logistical problems.



SnoTel Storage Gauge and Snow Pillow -- found throughout the mountains of Colorado and the western U.S.



**Hourglass Reservoir SnoTel Site:
Storage Gage (left) and Snow Pillow
(right)**

Hot Plate Gauge

No moving parts, does not require storing water



CARE Test Facility,
Egbert, Ontario

Urban Flood and Drainage Tipping Bucket Gage



City of Ft. Collins Flood Warning Gage, Ft. Collins Weather Station

CoAgMet Gauge

Common
non-heated
tipping bucket
gauge

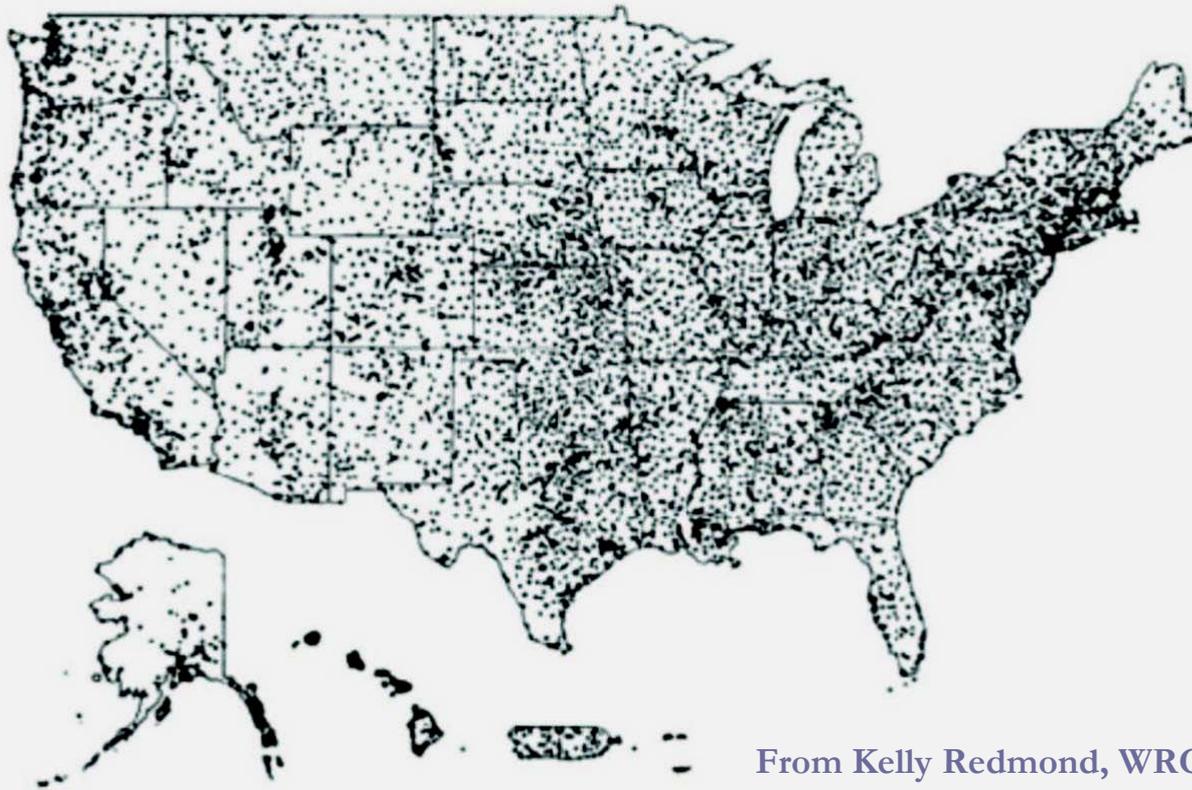
Low cost,
Reasonably
Reliable
Tends to
Under-report
Rainfall

Not good for
snow



CoAgMet -Ault,
CO (alt01)

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

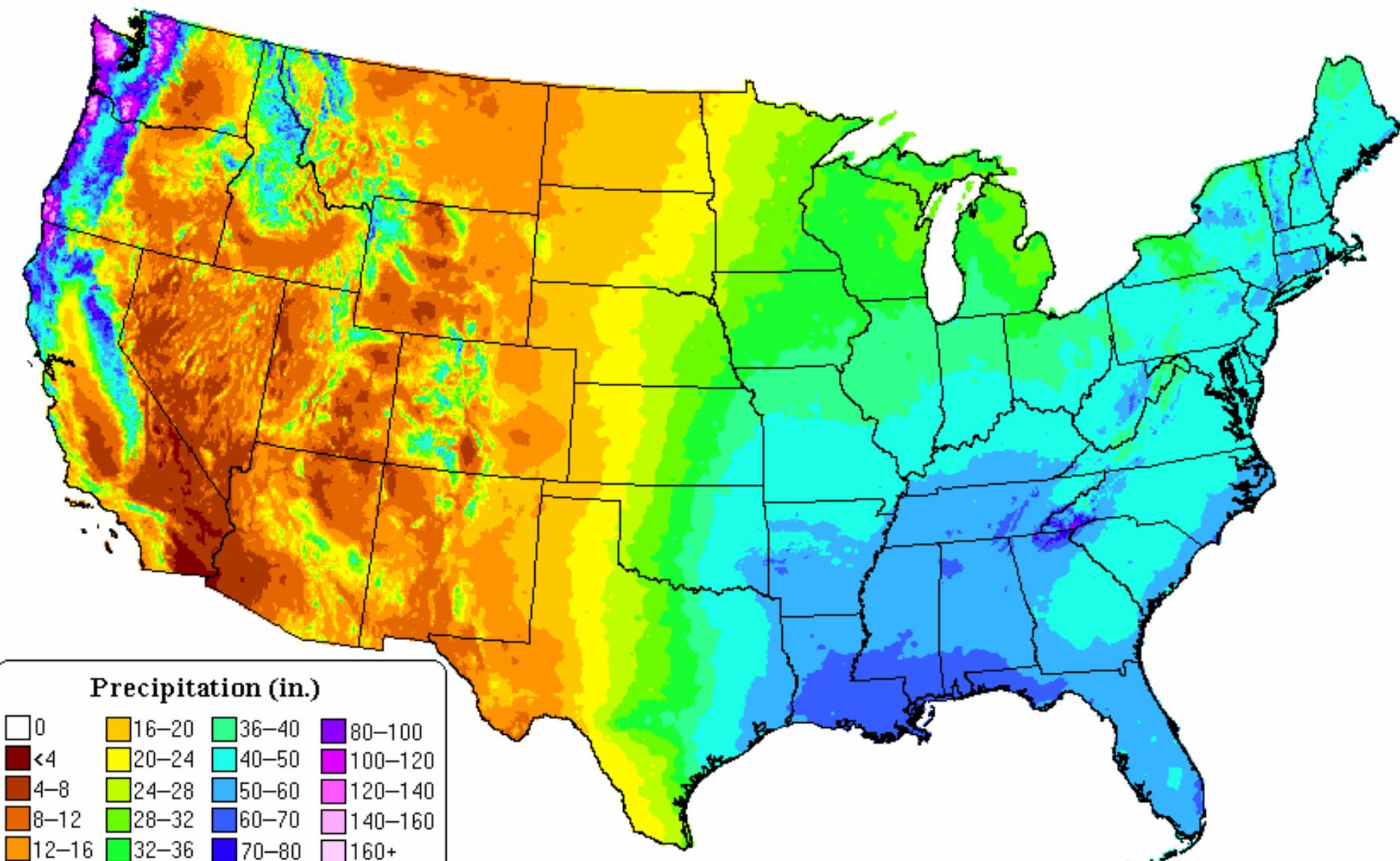


From Kelly Redmond, WRCC

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

What have we learned from long-term measurements of precipitation in the U.S.?

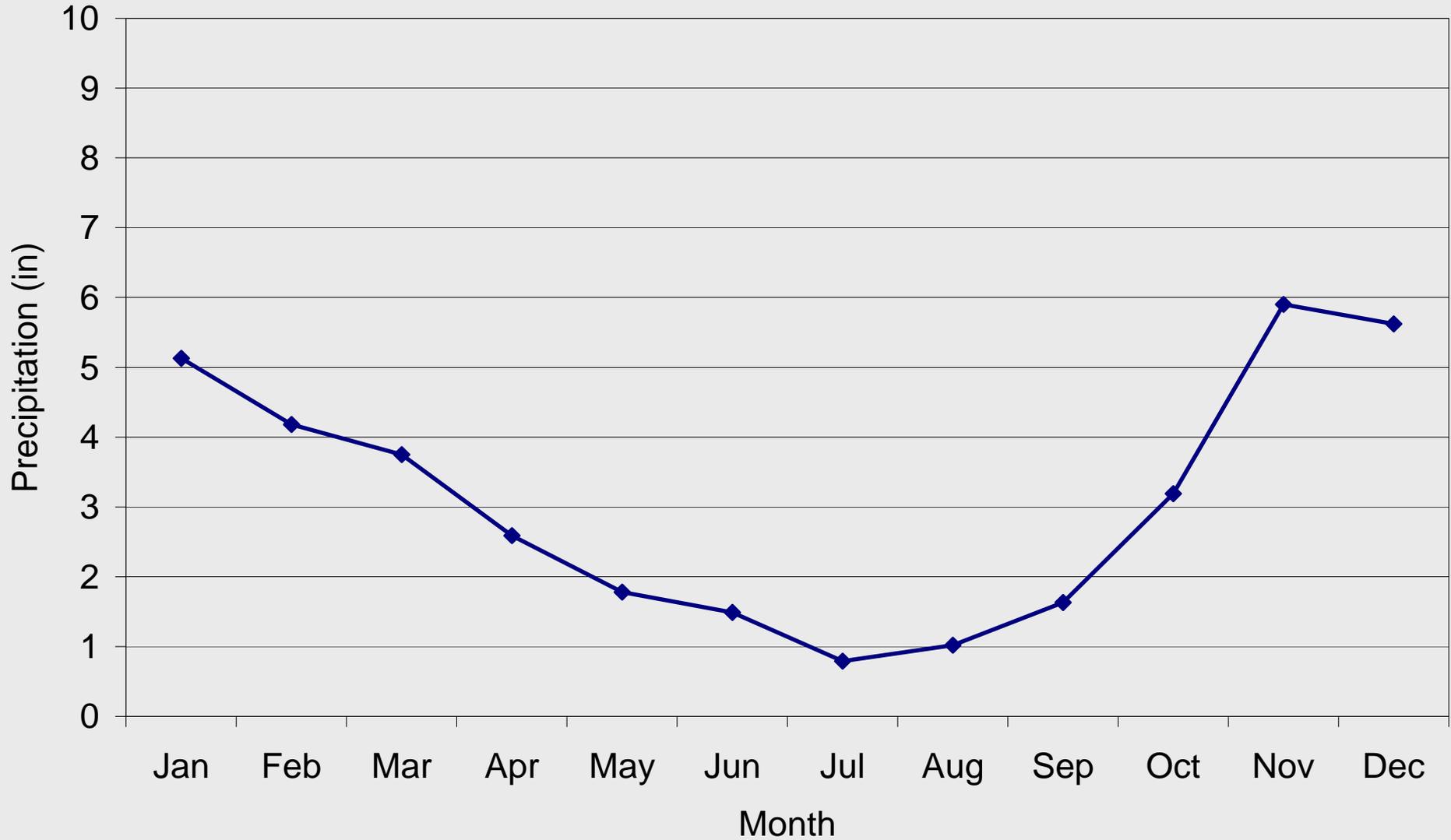
Precipitation: Annual Climatology (1971–2000)



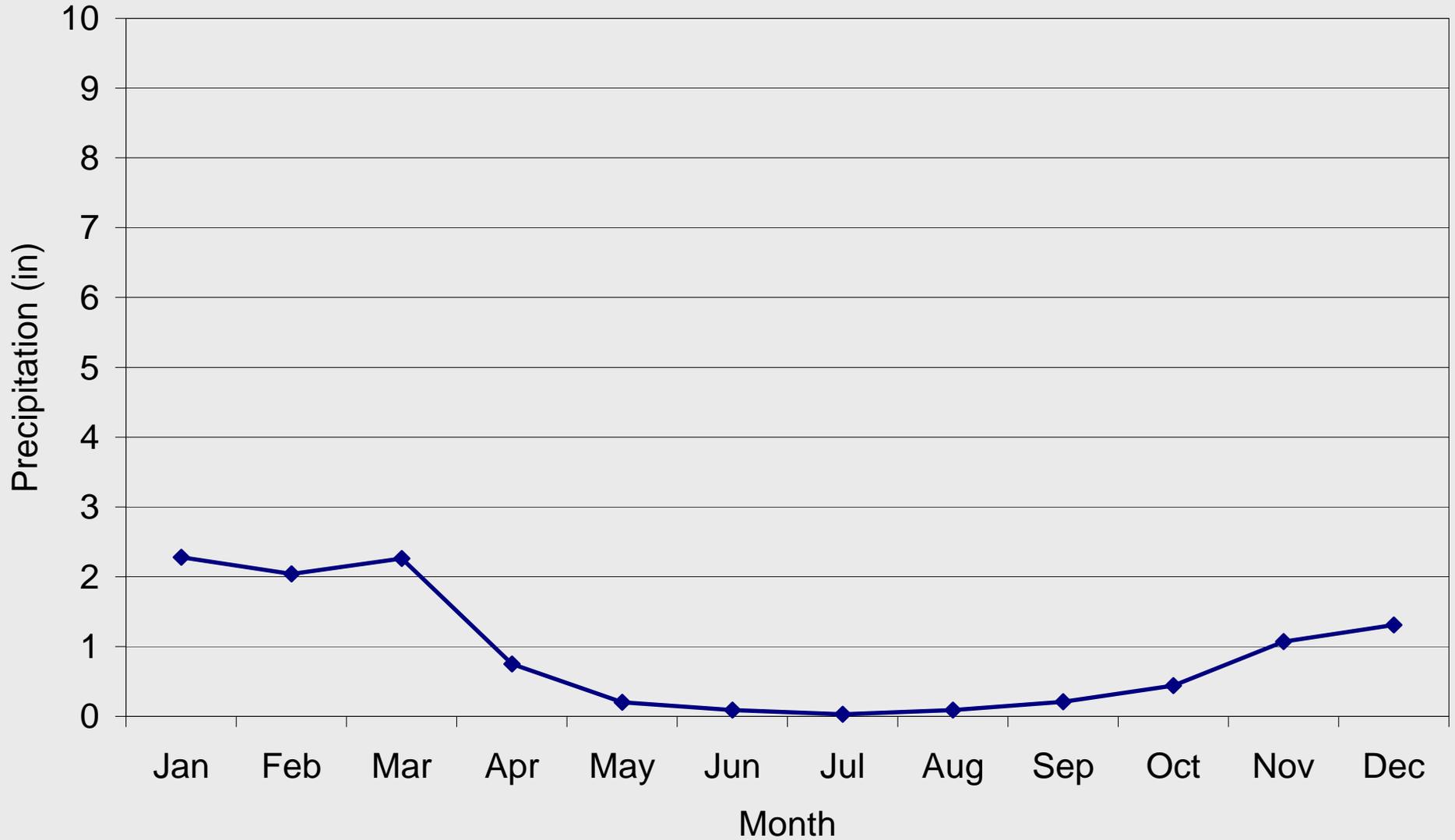
Huge geographic differences in
average annual rainfall

Also dramatic differences in
seasonal distributions

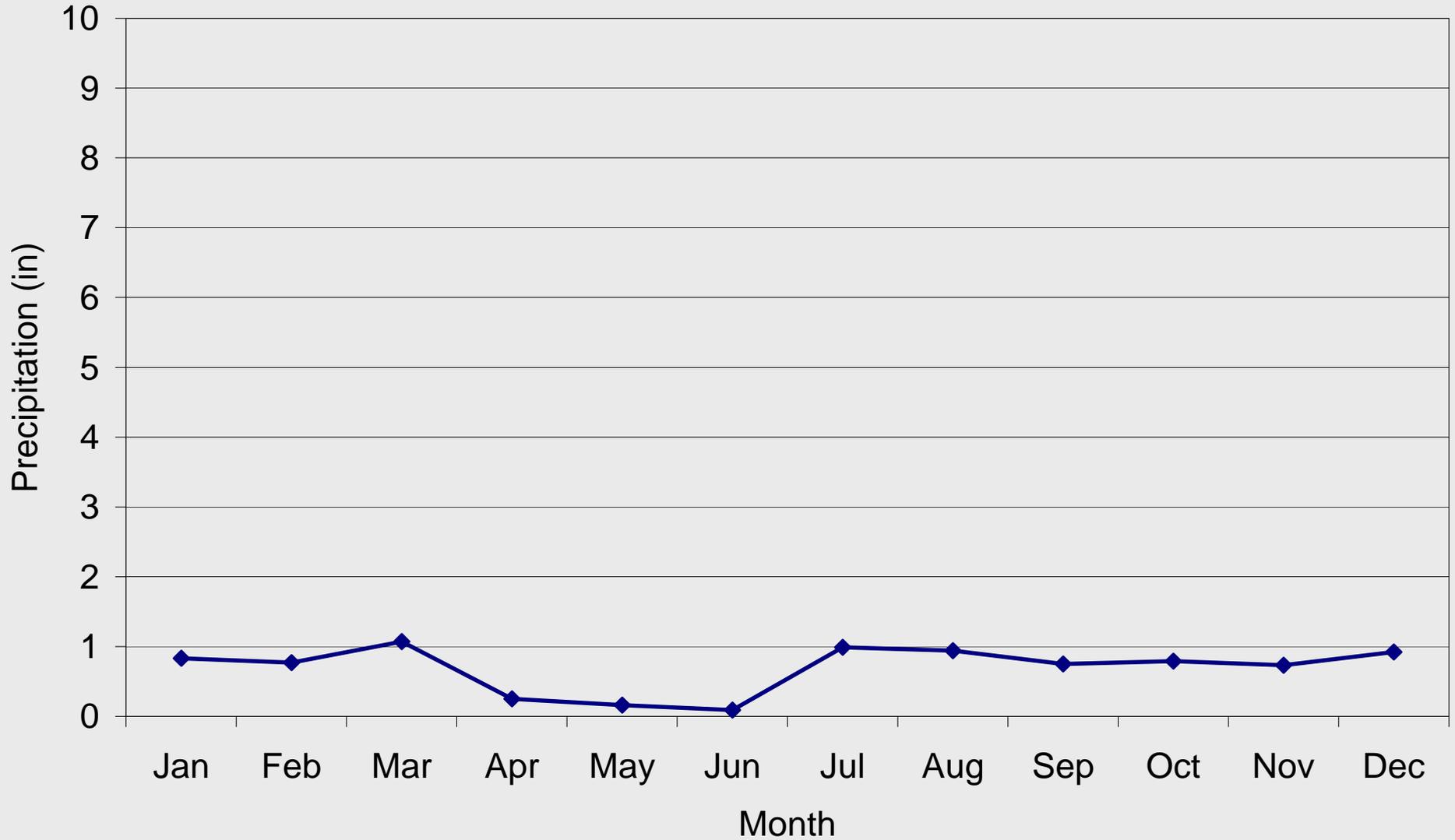
Seattle, WA Monthly Normal Precipitation



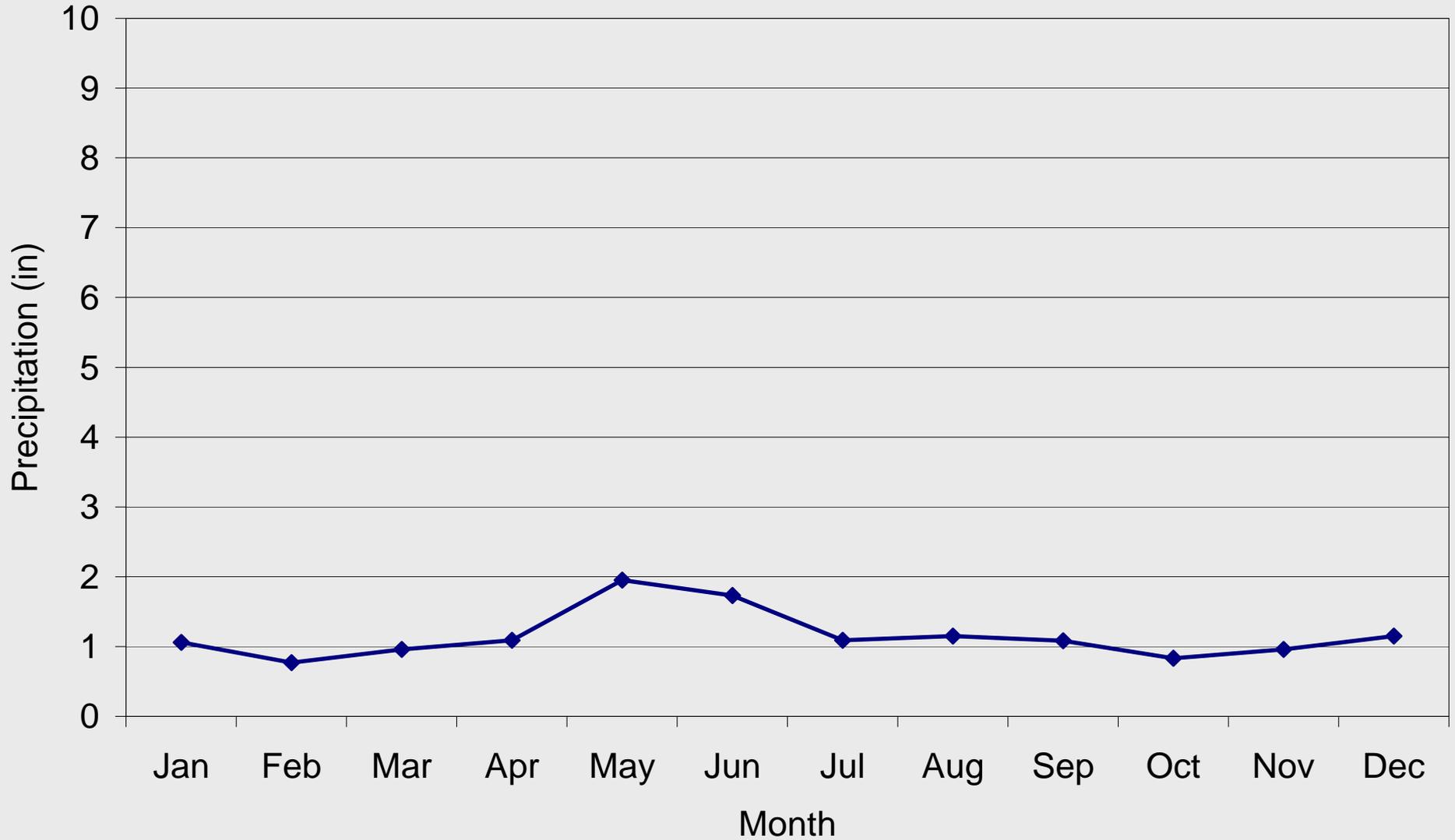
San Diego, CA Monthly Normal Precipitation



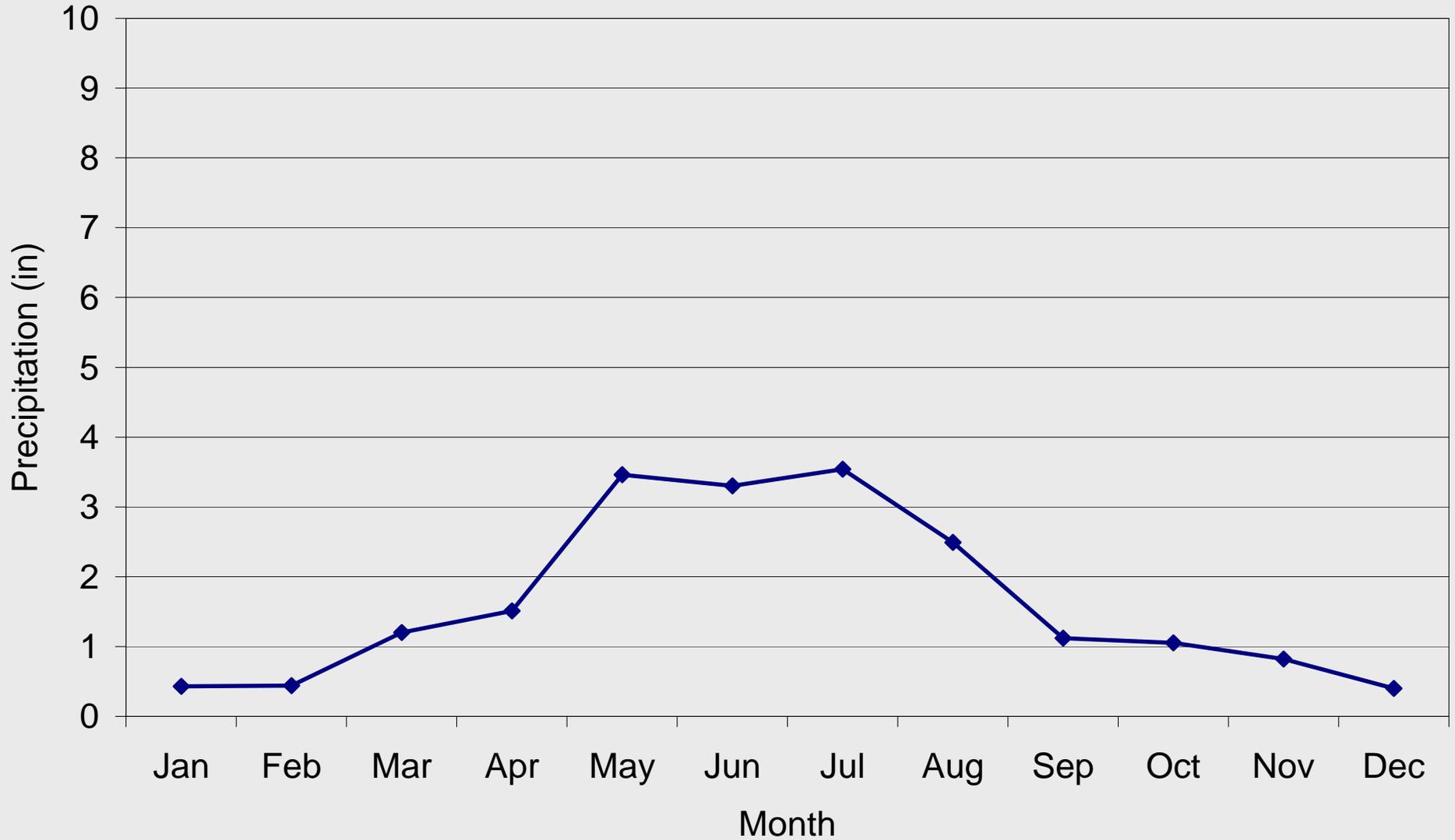
Phoenix, AZ Monthly Normal Precipitation



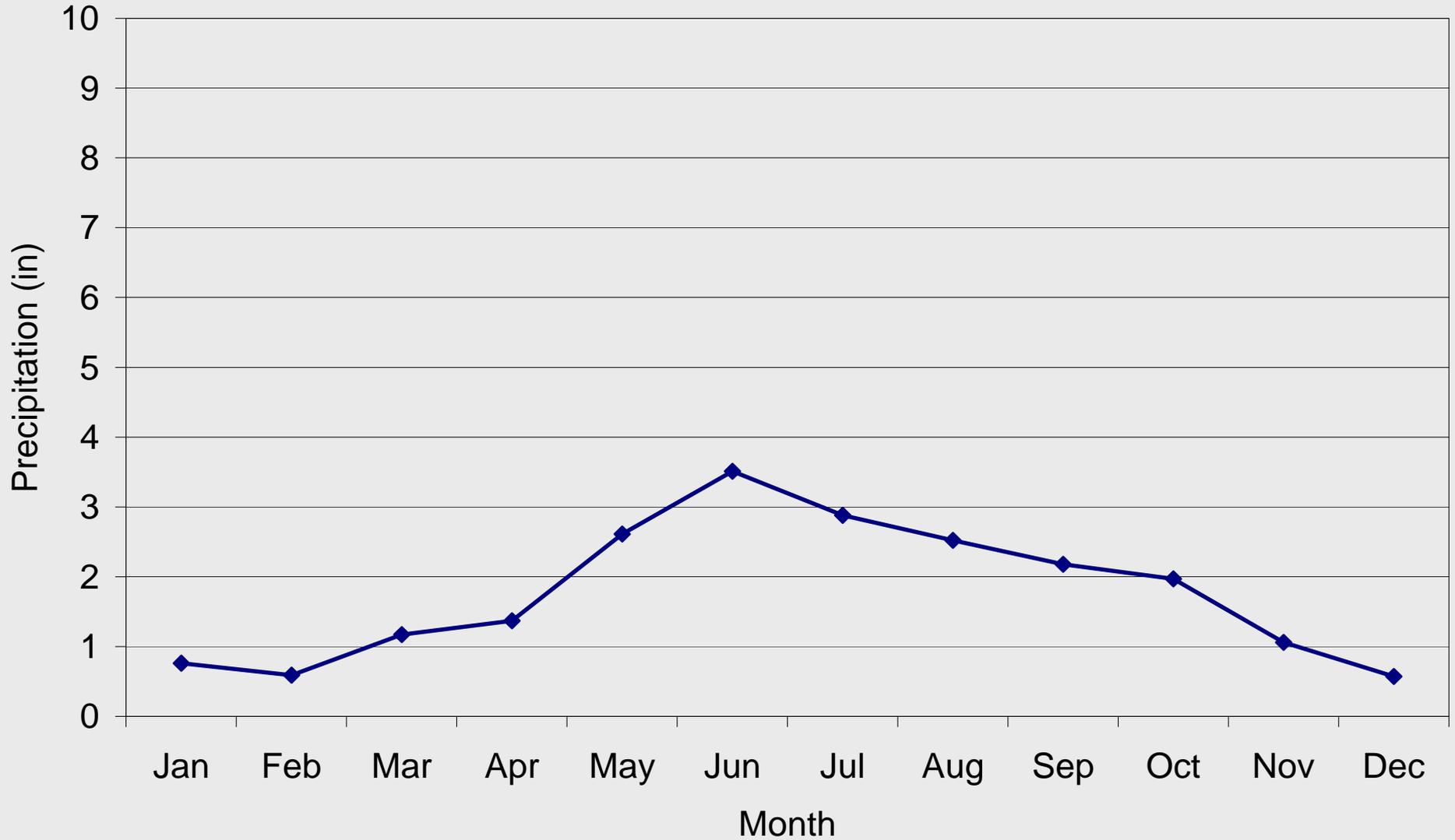
Missoula, MT Monthly Normal Precipitation



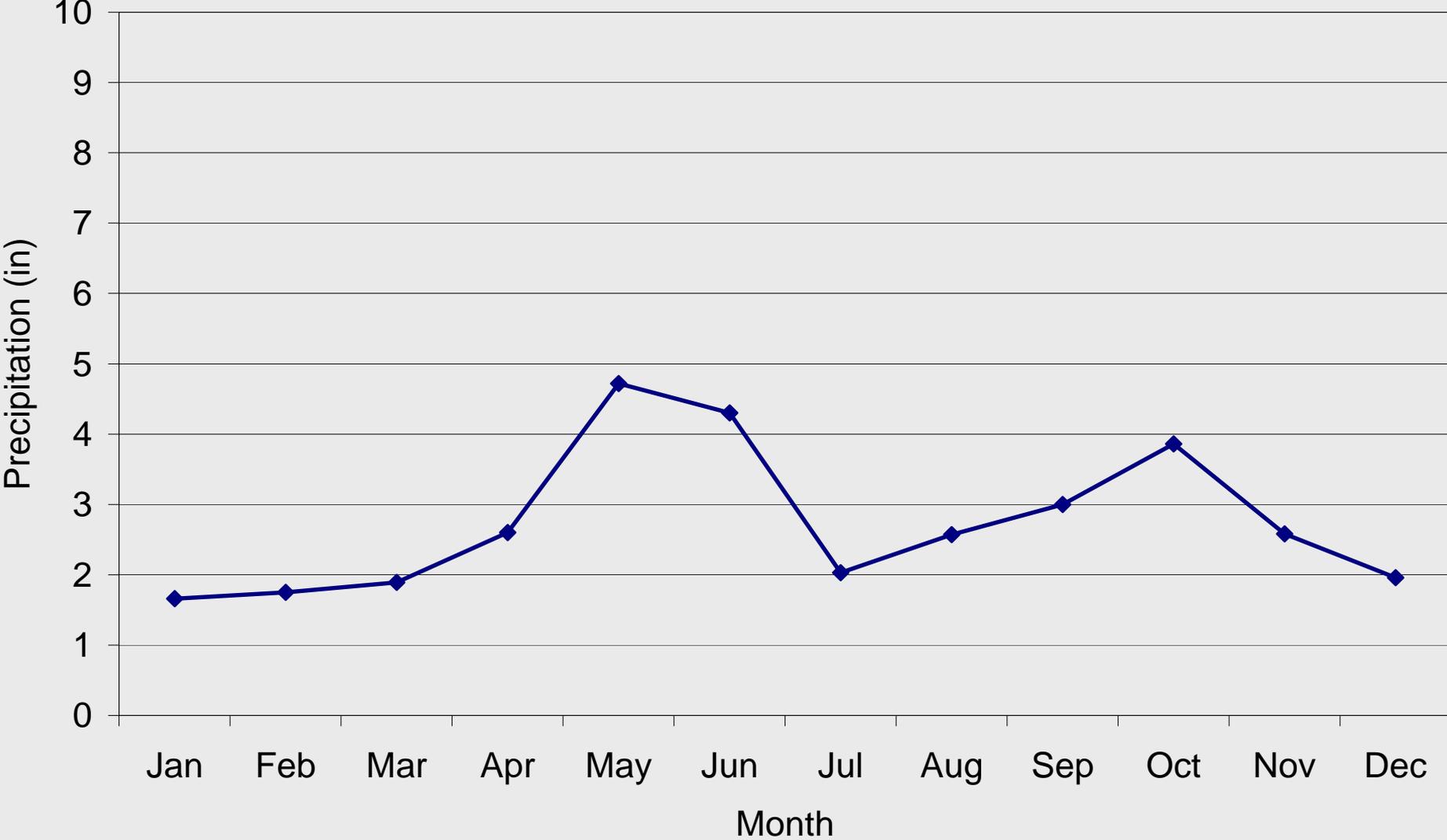
Goodland, KS Monthly Normal Precipitation



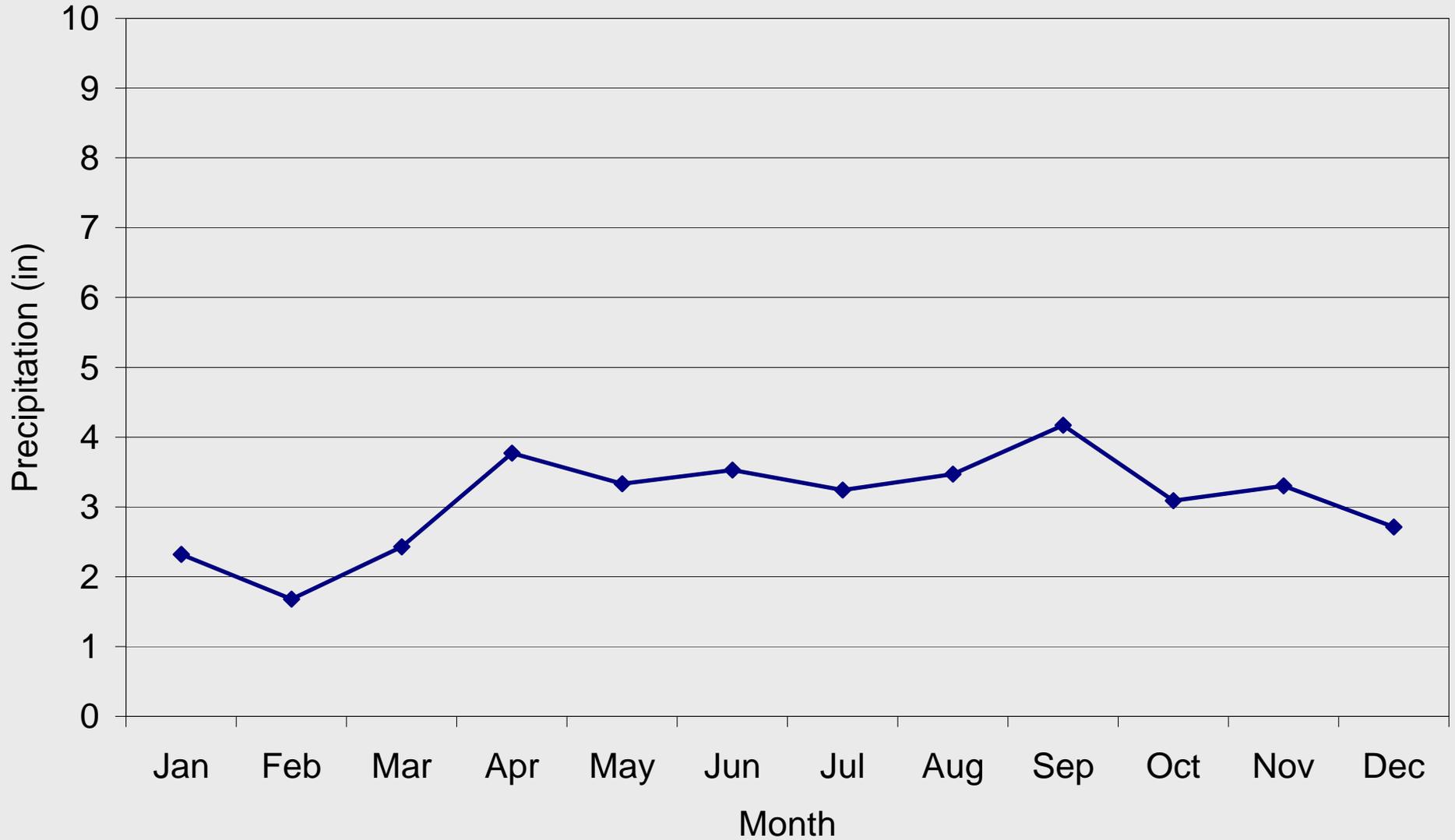
Fargo, ND Monthly Normal Precipitation



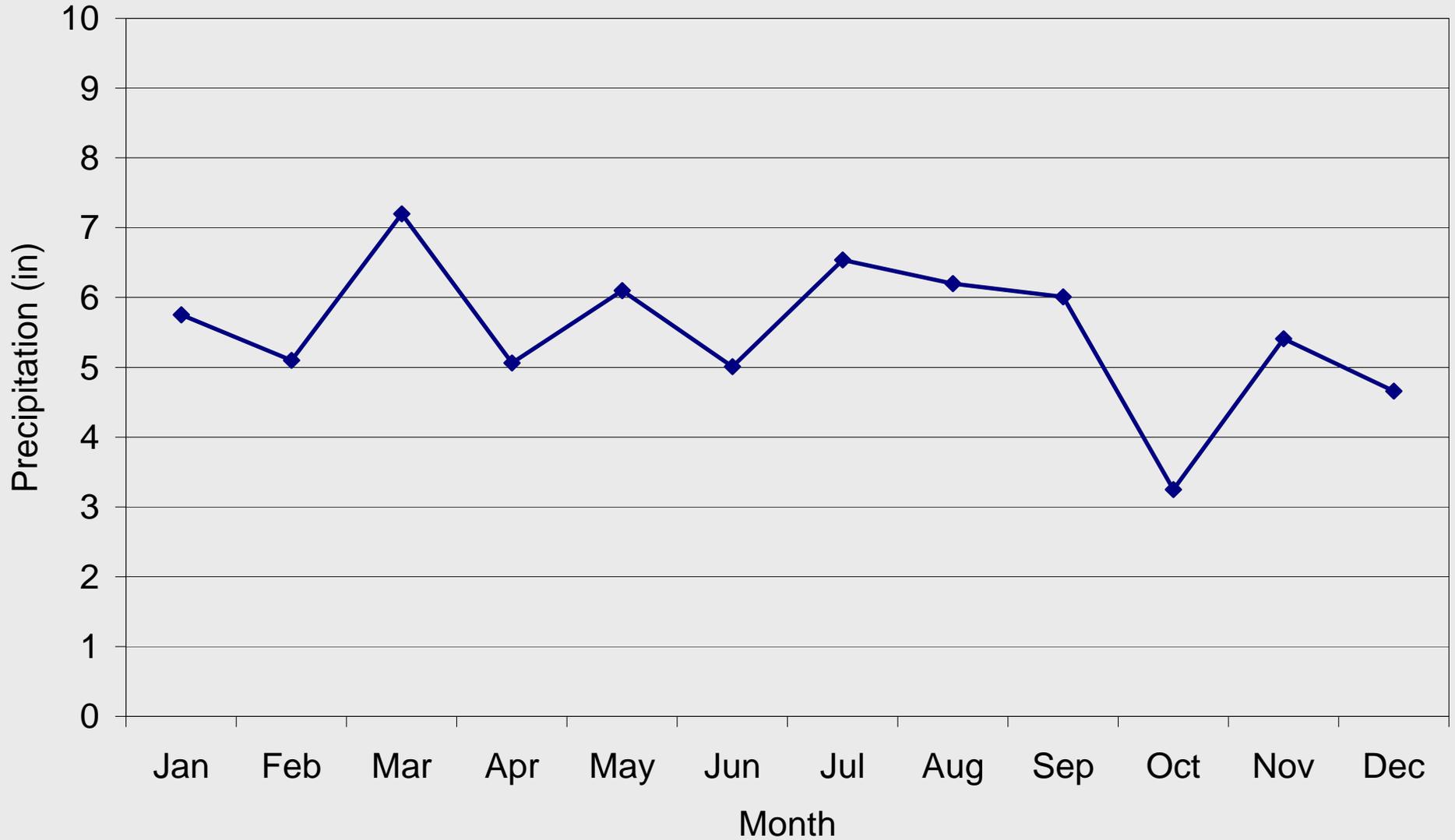
San Antonio, TX Monthly Normal Precipitation



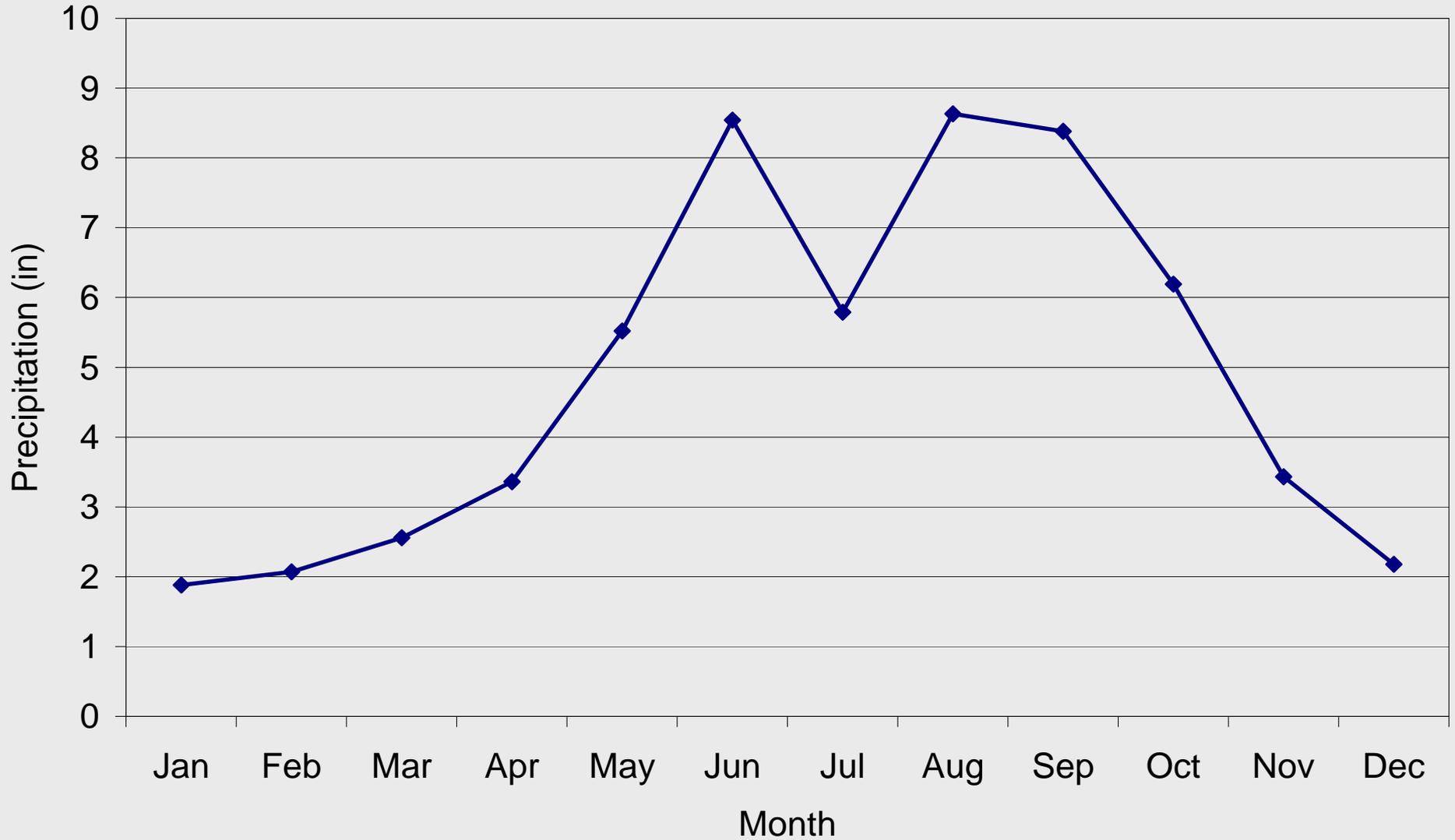
Benton Harbor, MI Monthly Normal Precipitation



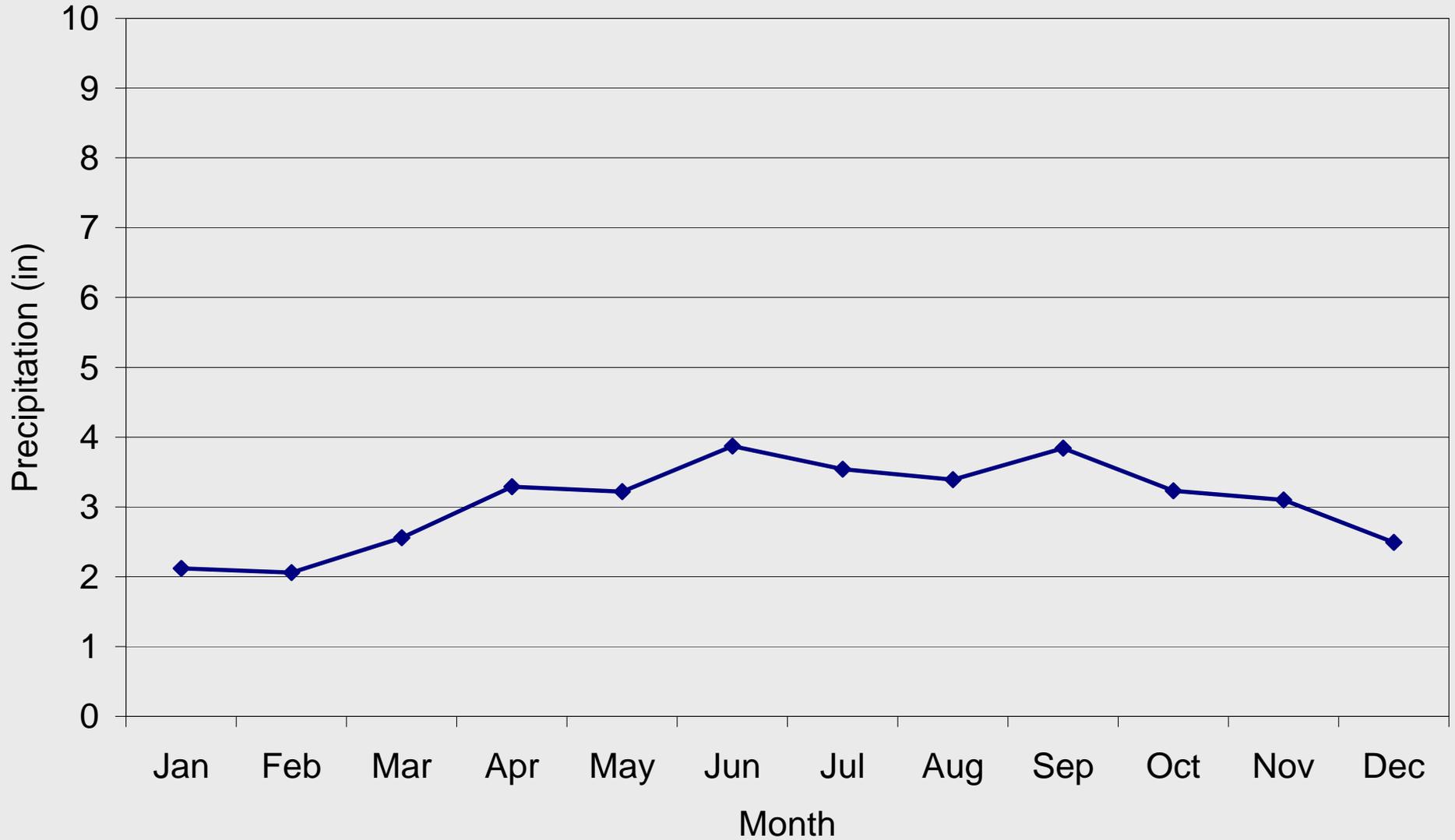
Mobile, AL Monthly Normal Precipitation



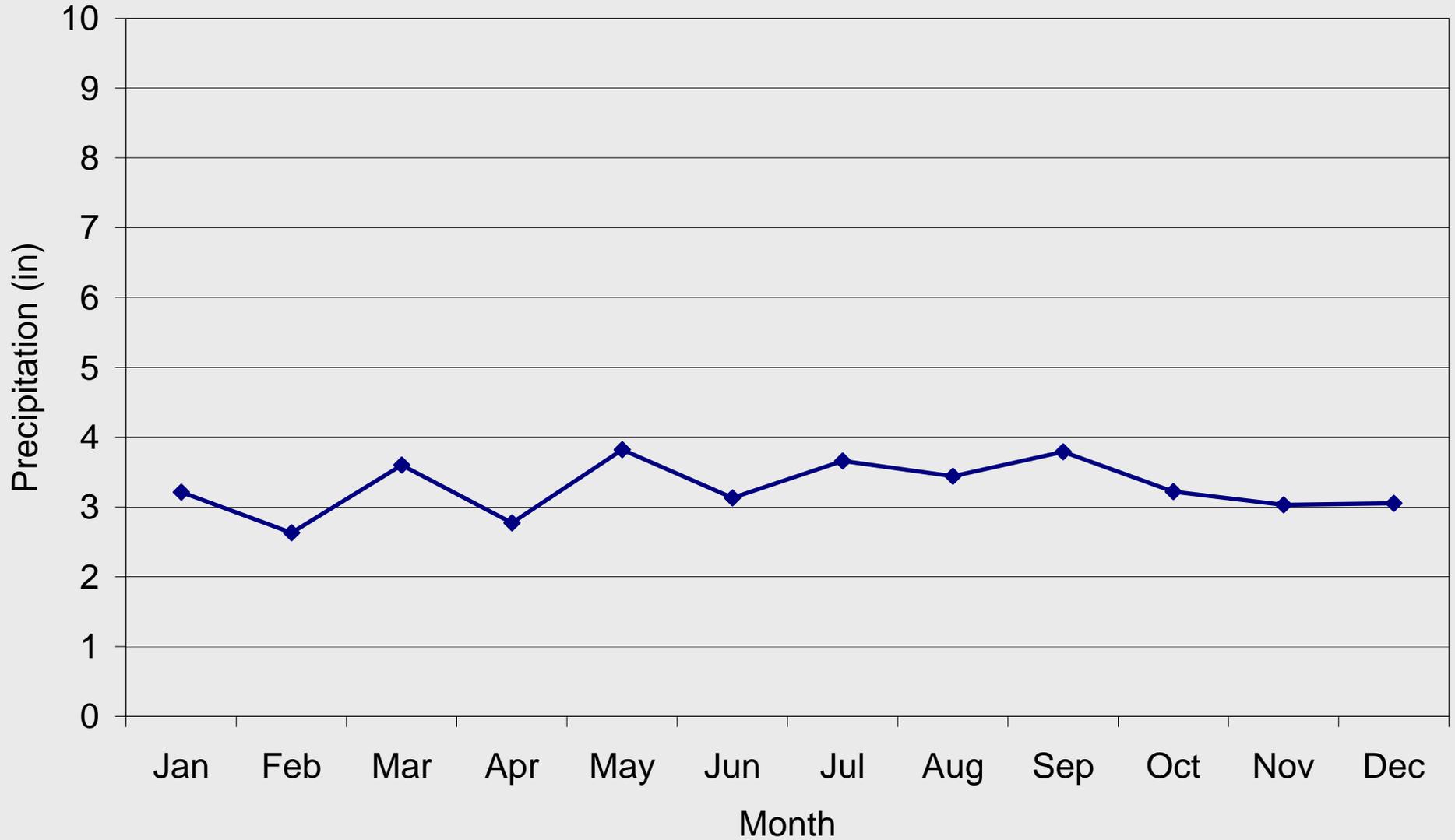
Miami, FL Monthly Normal Precipitation



Ithaca, NY Monthly Normal Precipitation



Washington D.C. Monthly Normal Precipitation



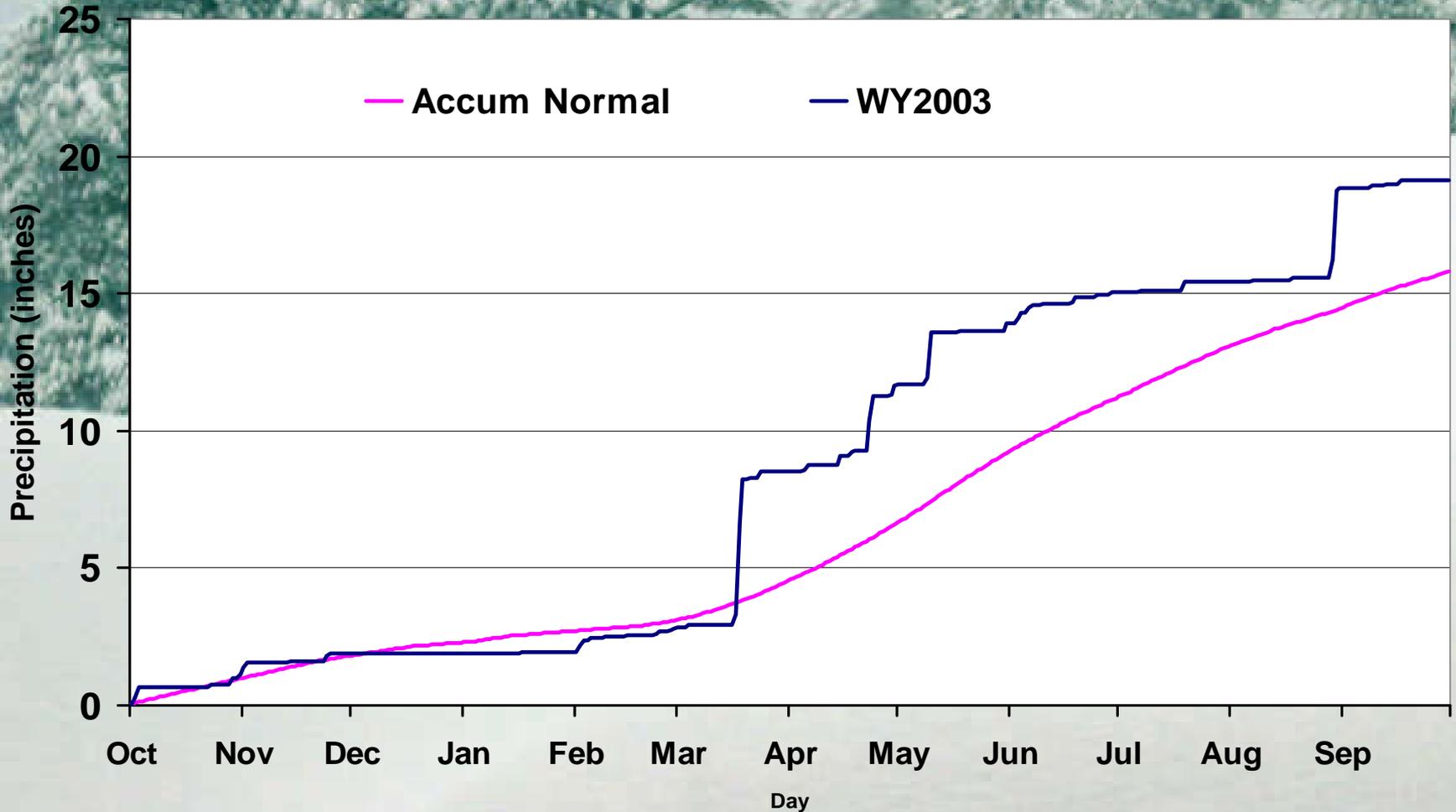
Averages are great, but when is the
last time you received average
precipitation?

Large Year-to-Year Variations in Precipitation



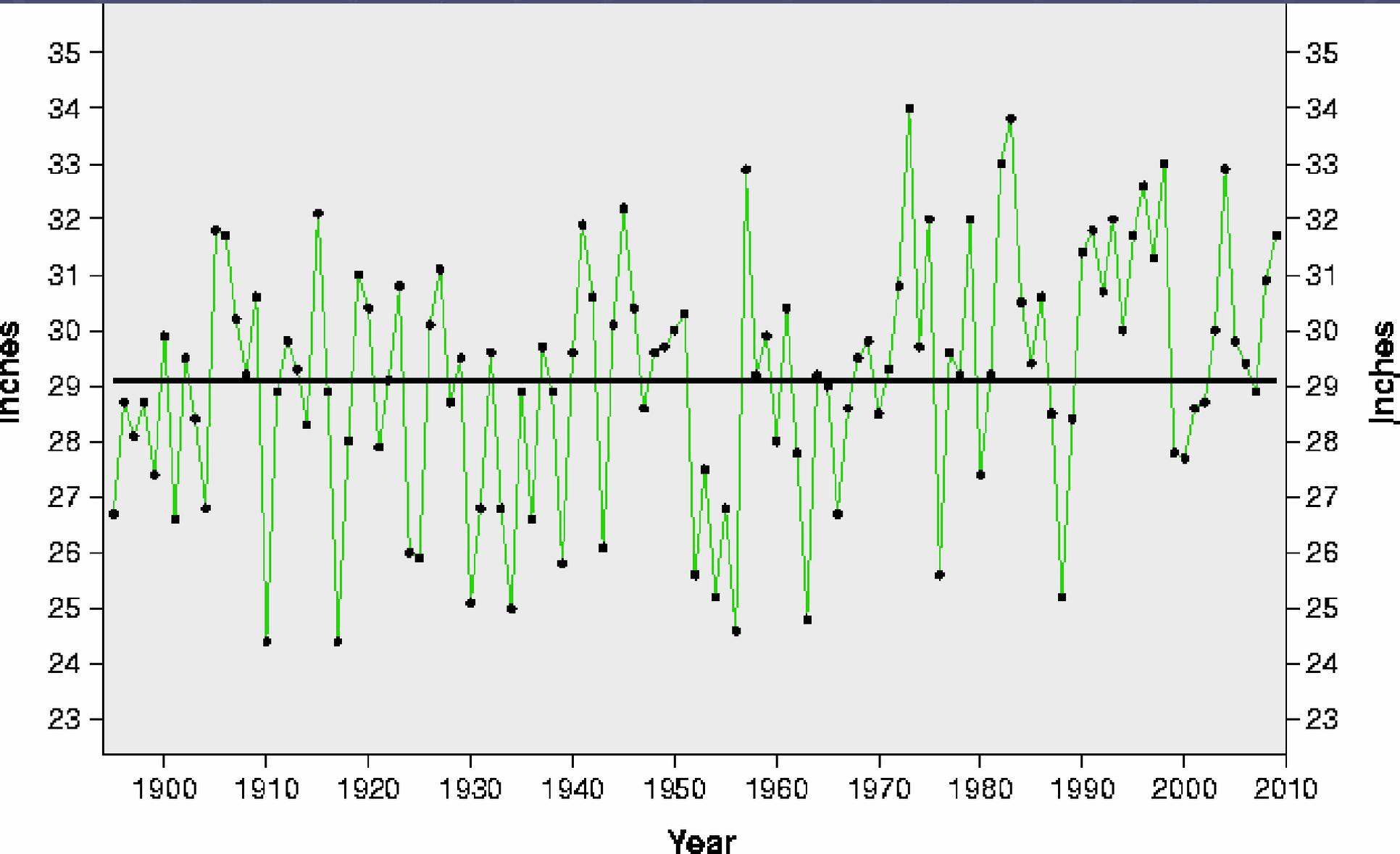
In semi-arid areas like here, a few storms contribute a large fraction of the annual precipitation in many years

Fort Collins Daily Accumulated Precipitation

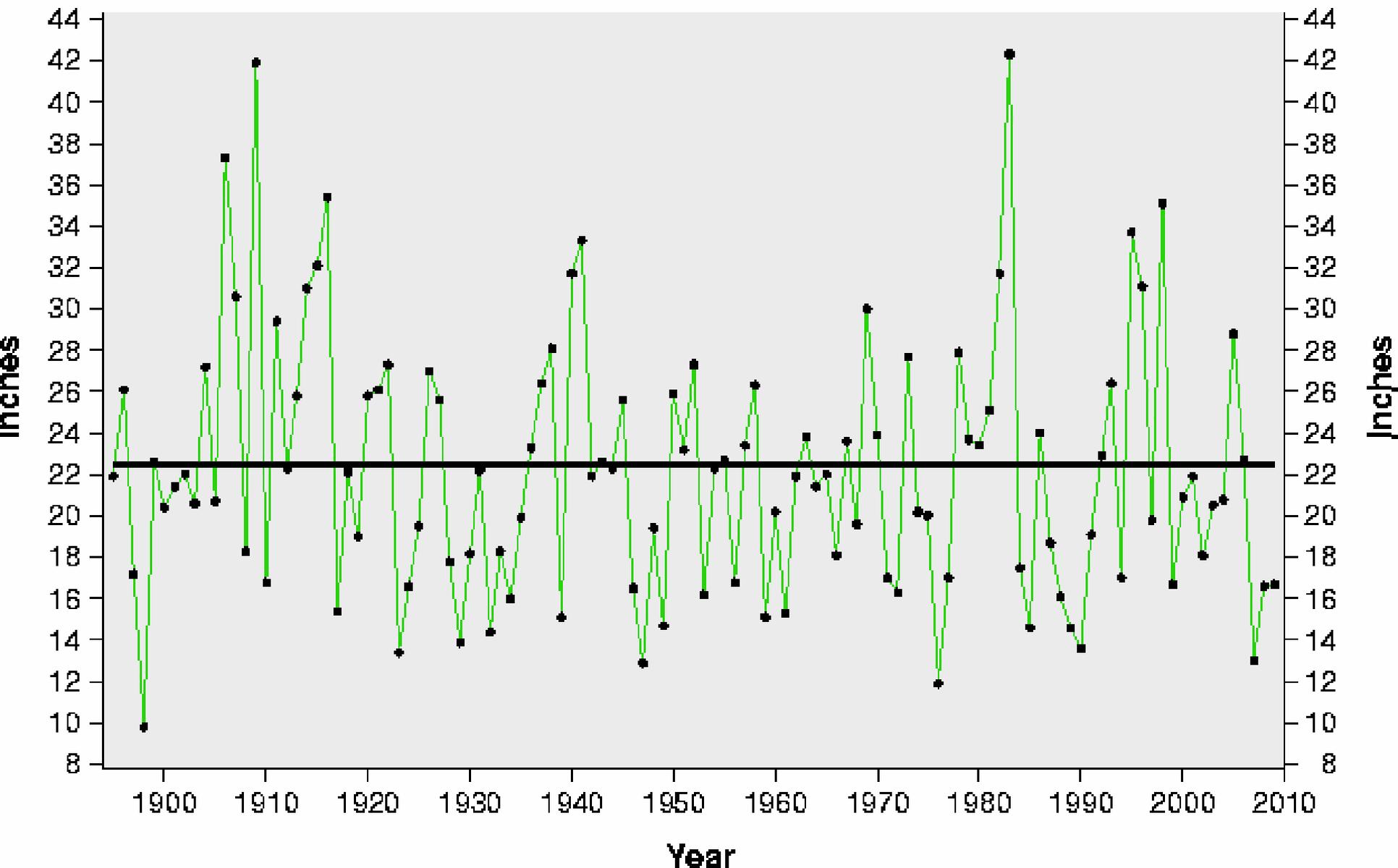


How much does precipitation
vary from year to year?

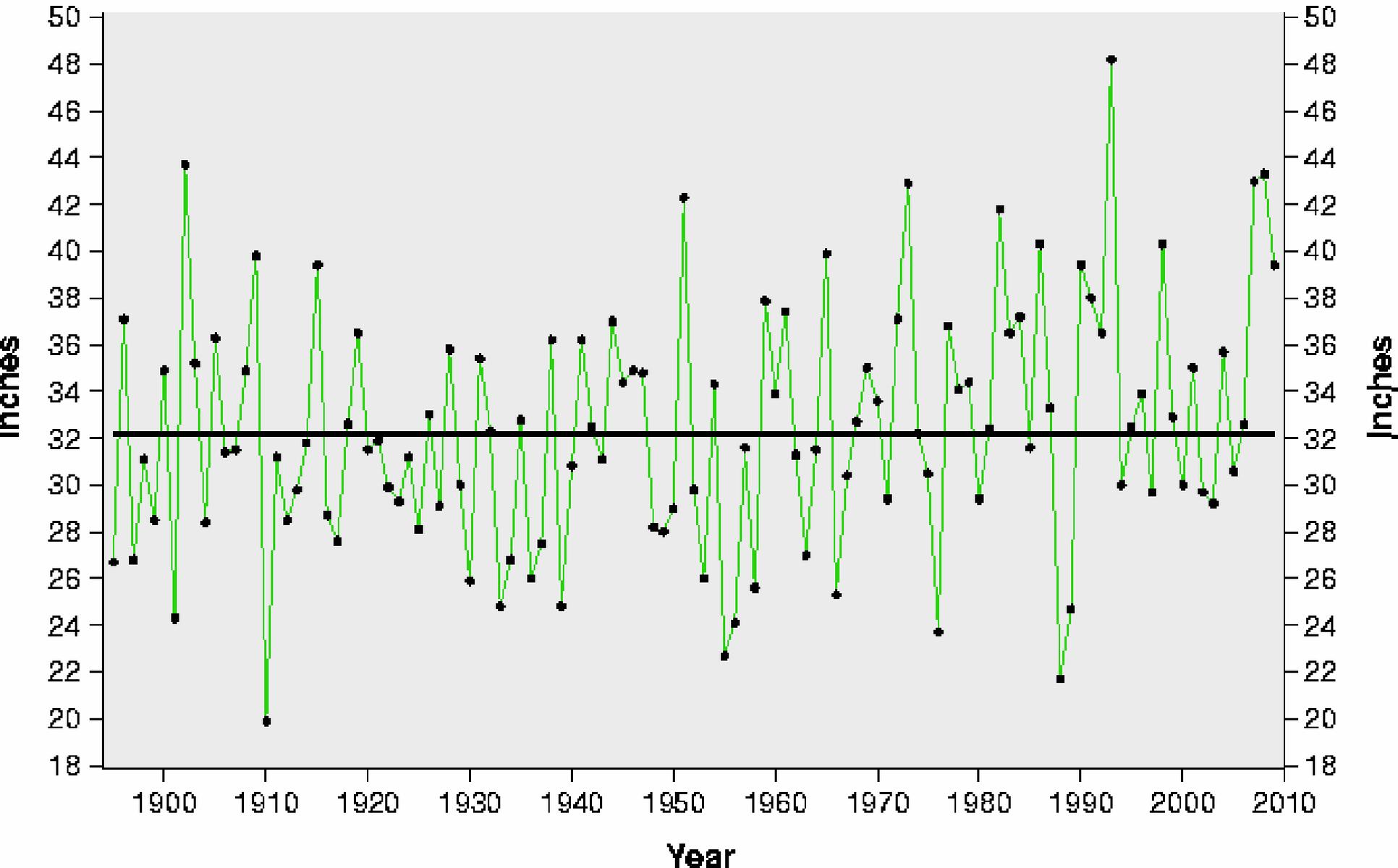
U.S. Annual Precipitation History



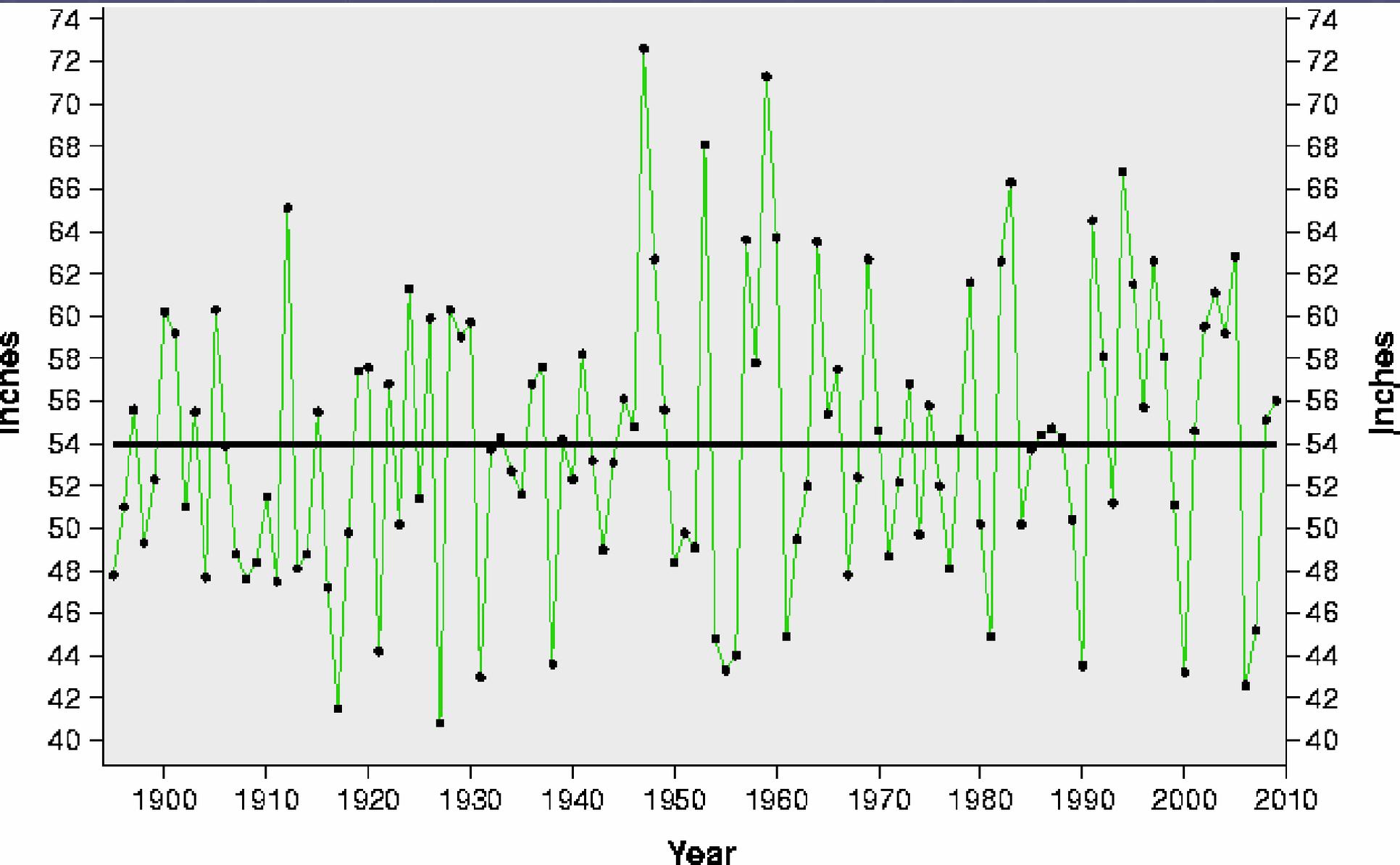
CA Annual Precipitation History



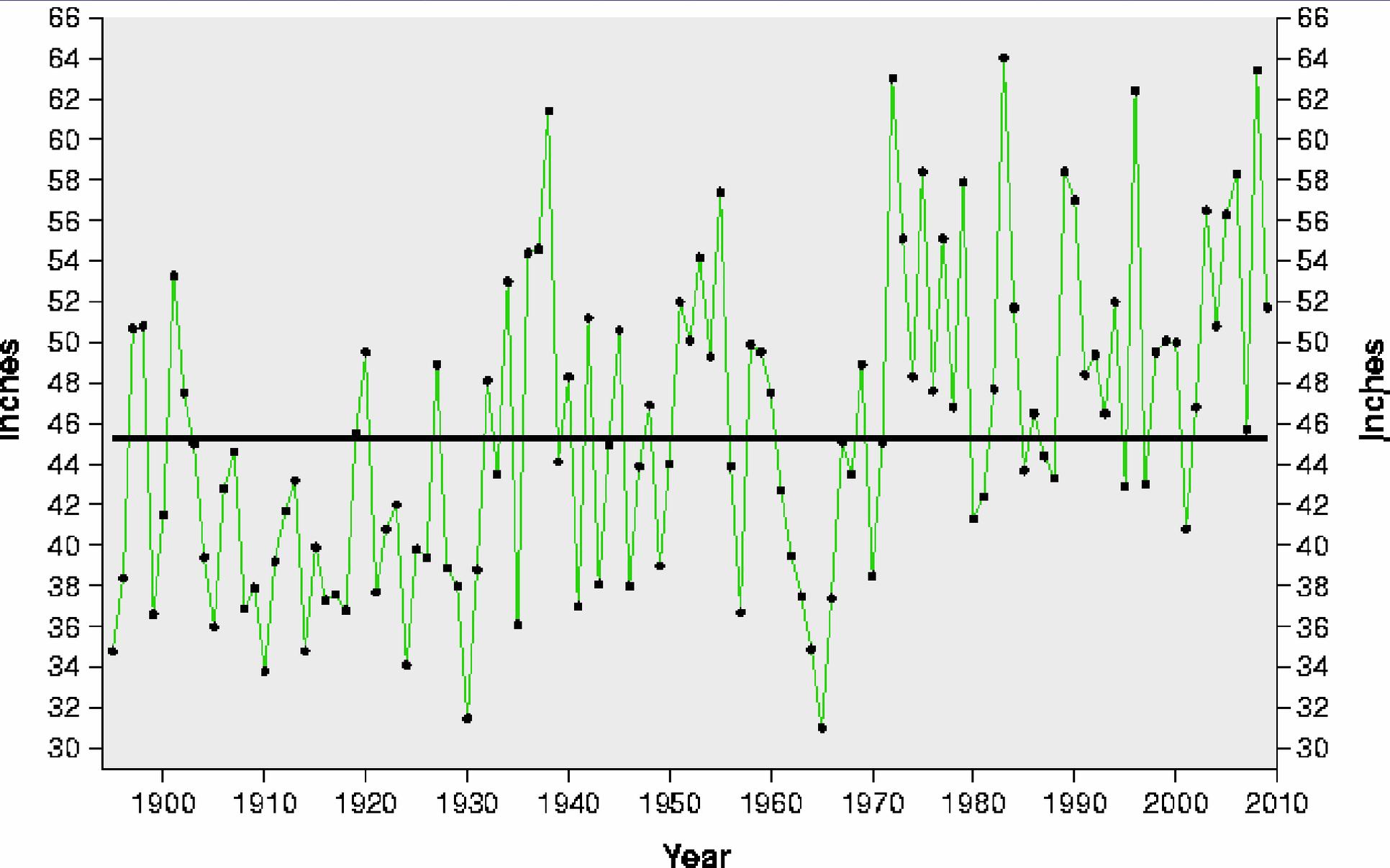
IA Annual Precipitation History



FL Annual Precipitation History



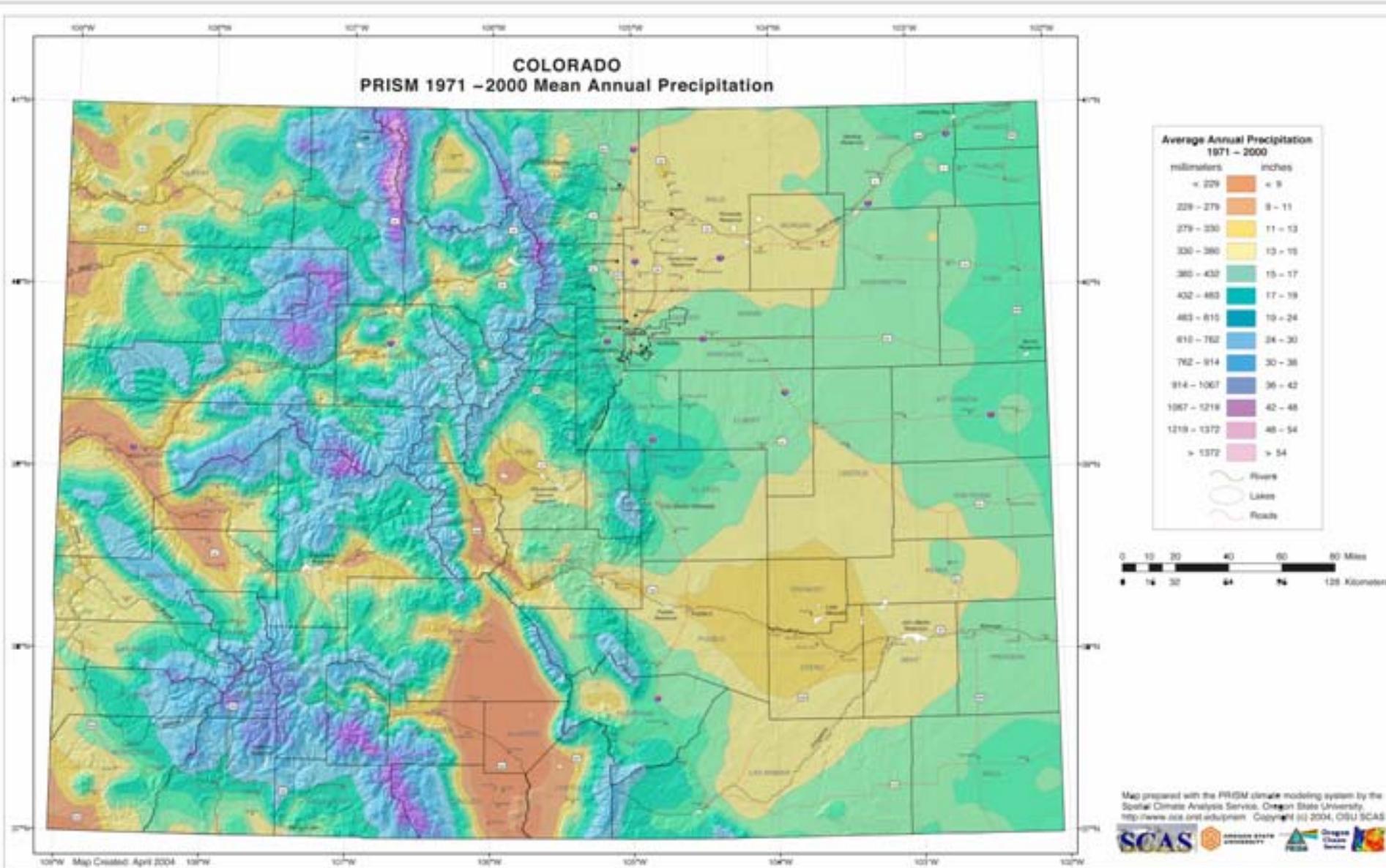
CT Annual Precipitation History



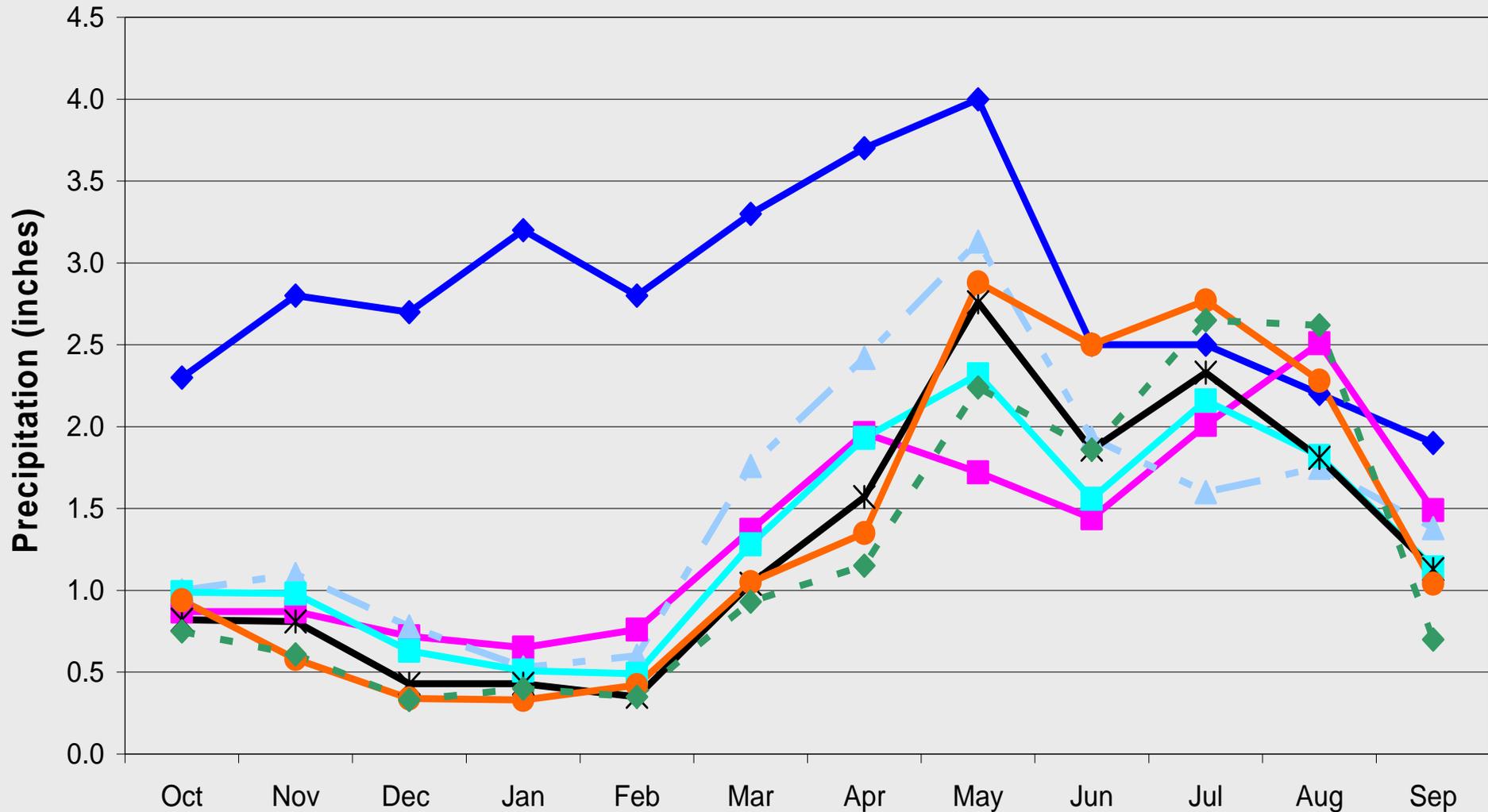
Home to Colorado



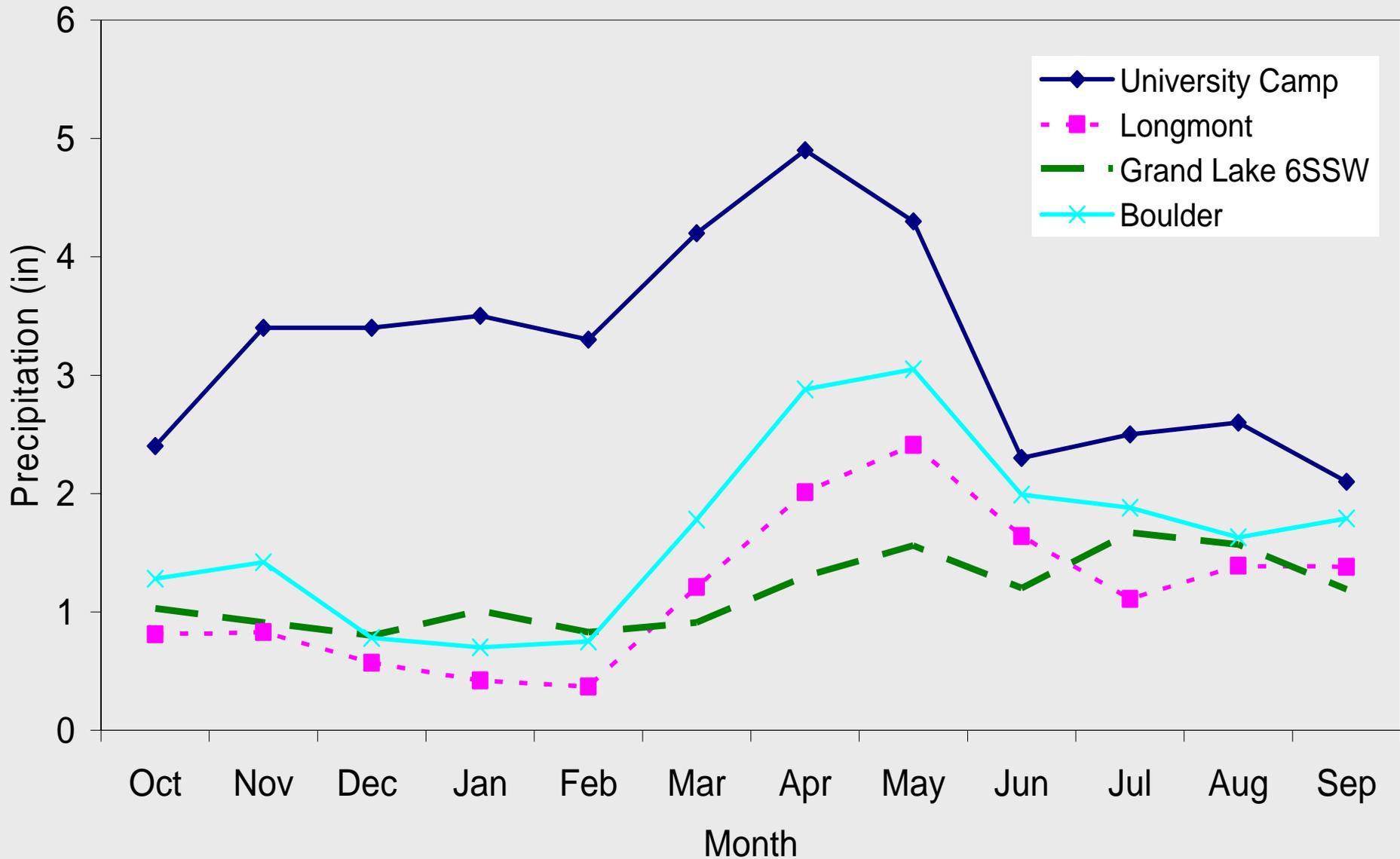
Colorado Average Annual Precipitation Map



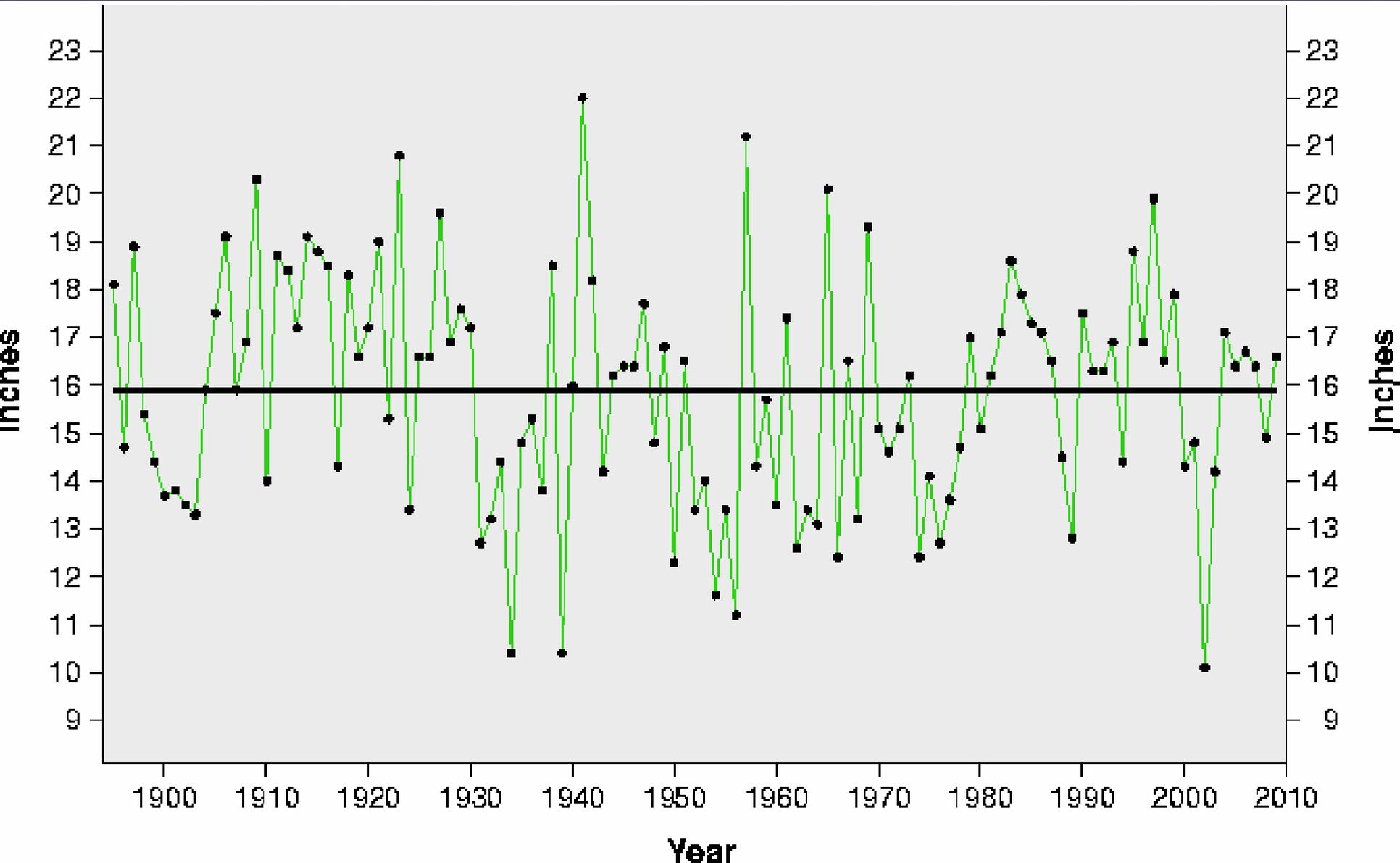
Water Year Average Precipitation for Selected Stations in the I-70 Transect



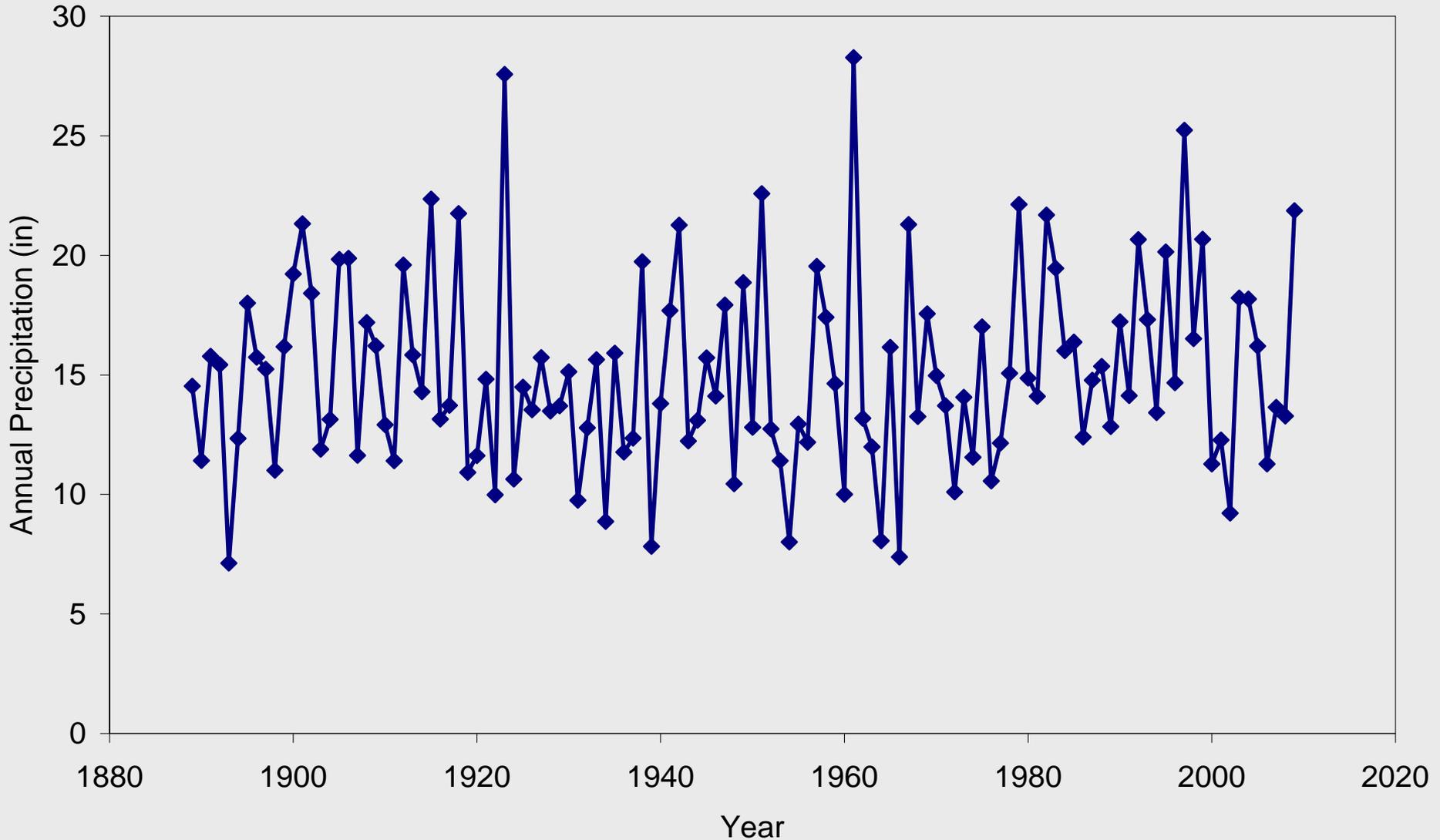
Water Year Average Monthly Precipitation for Selected Colorado Locations Near Boulder



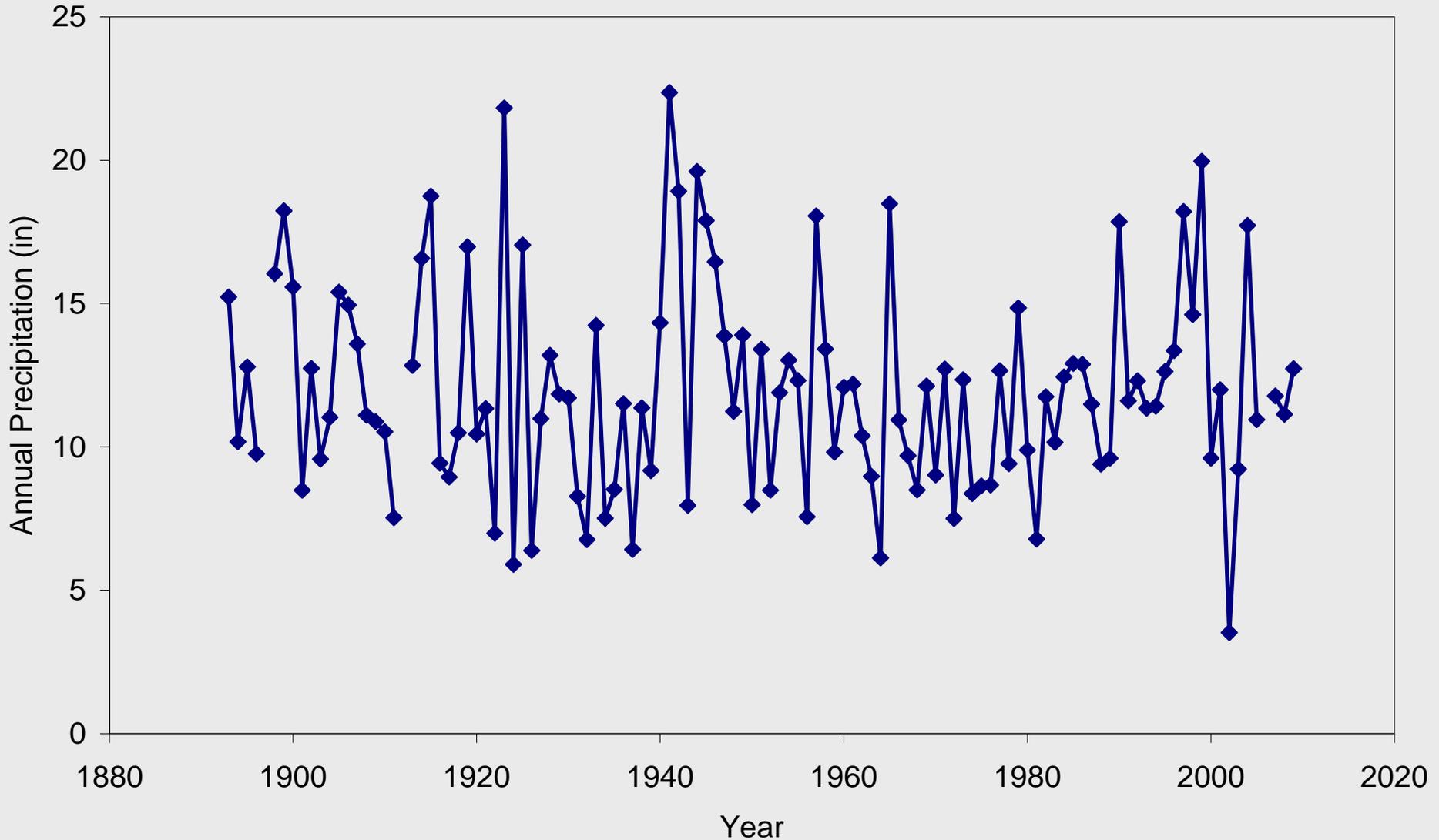
CO Annual Precipitation History



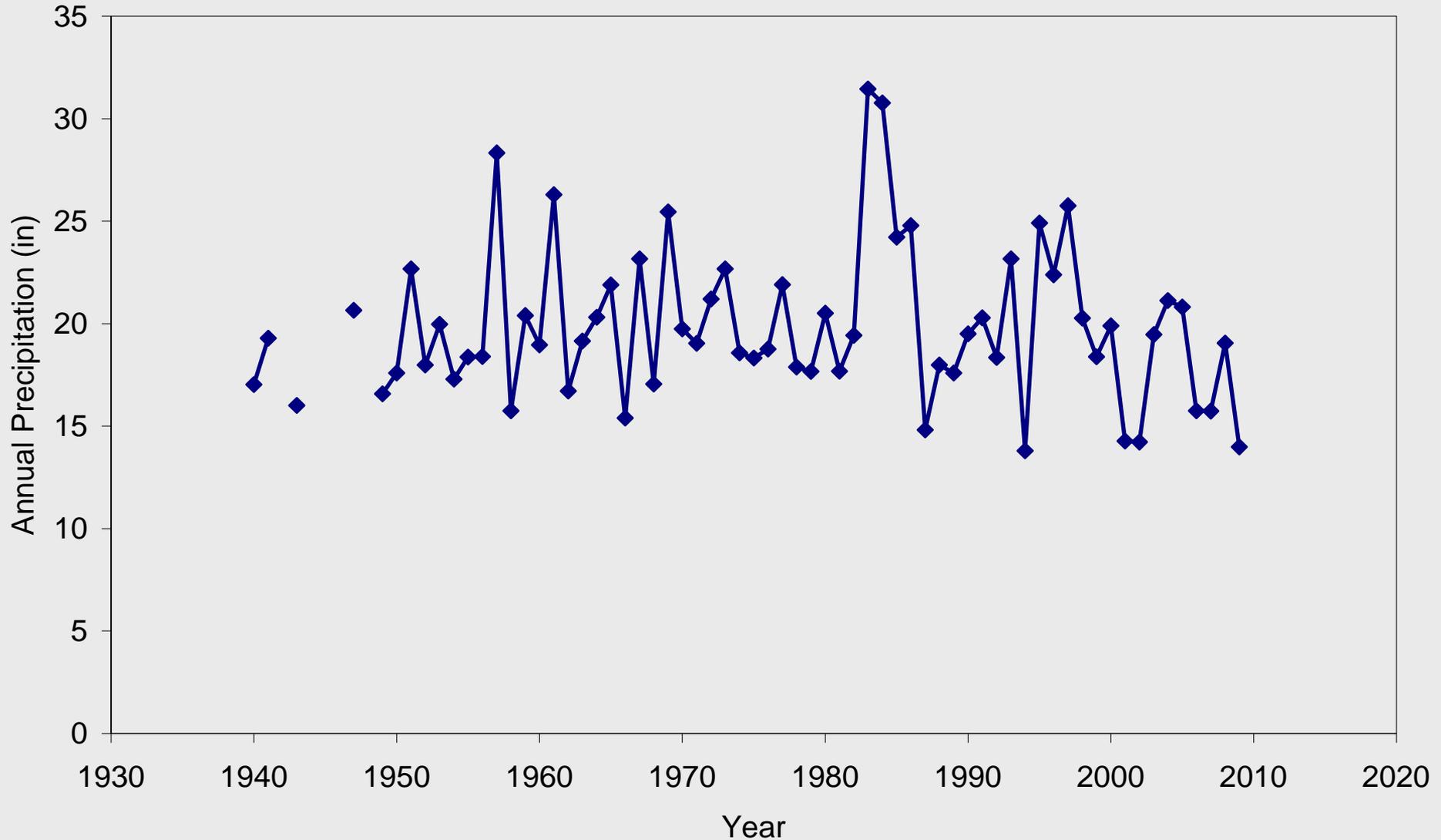
Fort Collins Annual Precipitation



Rocky Ford Annual Precipitation



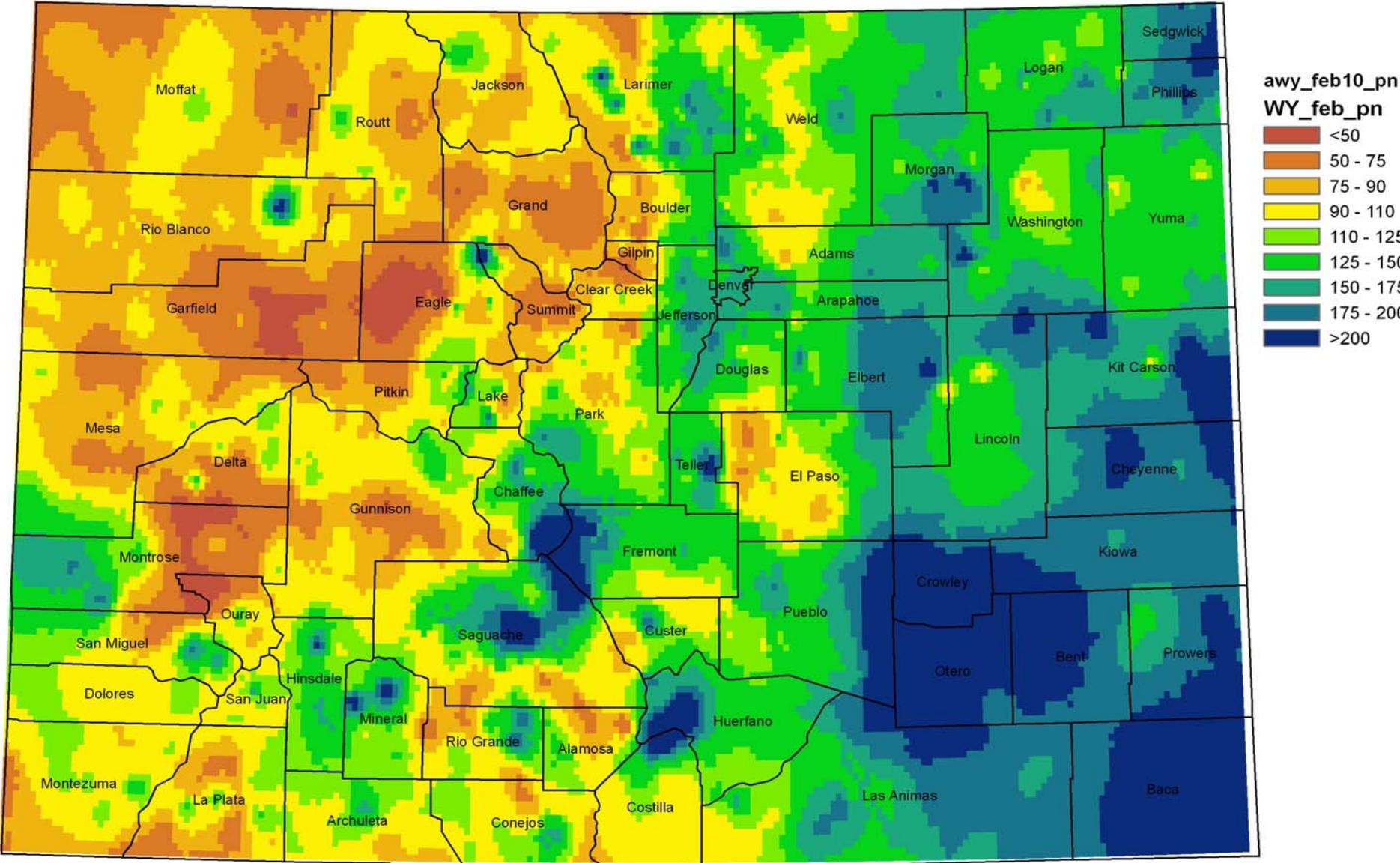
Grand Lake 1NW Annual Precipitation



As State Climatologist for Colorado, I spend the majority of my time measuring, analyzing, talking about and writing about precipitation.

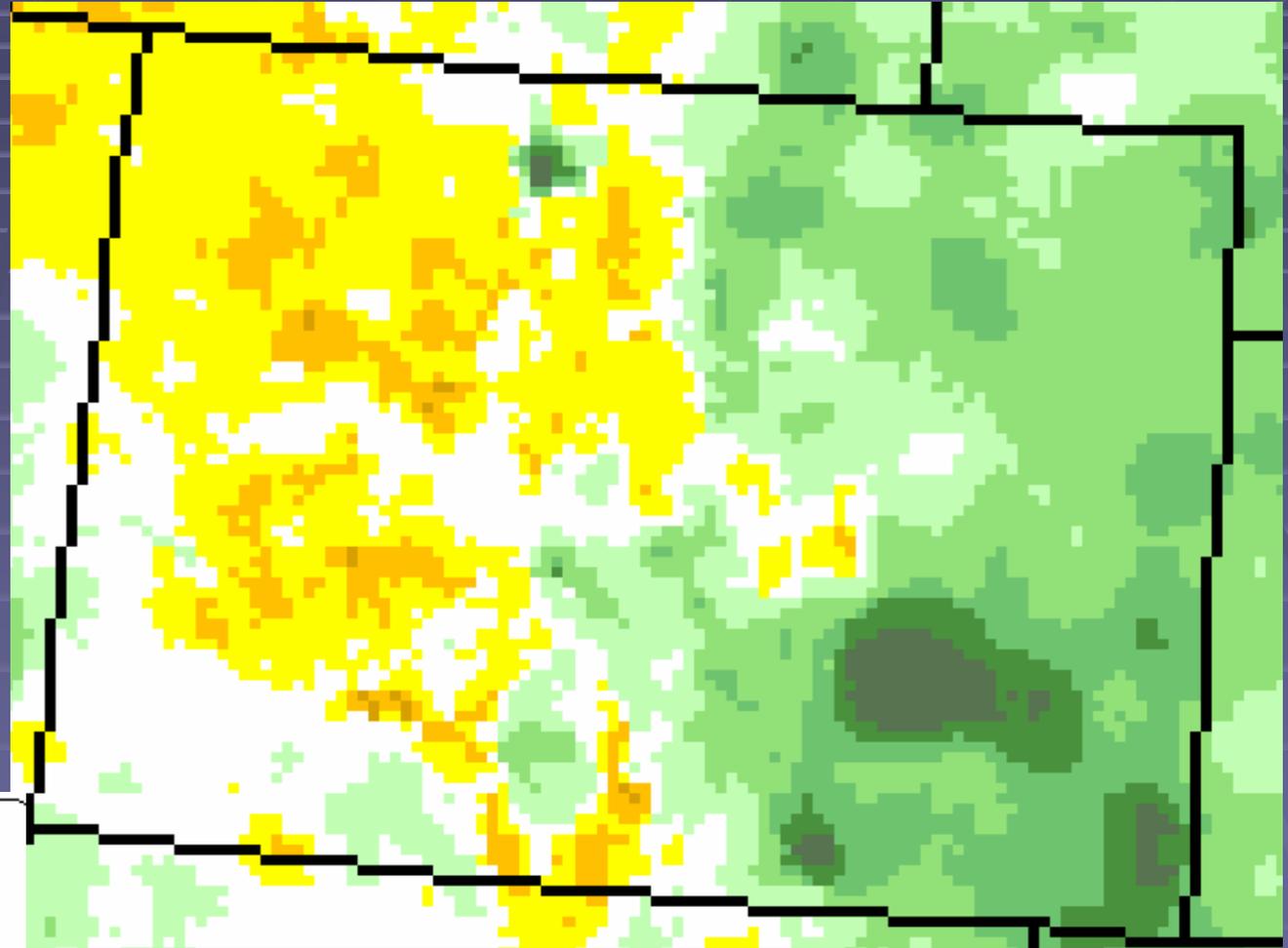
Like it or not, it matters!!

Colorado Water Year 2010 Precipitation as Percent of Normal Oct 2009 - Feb 2010

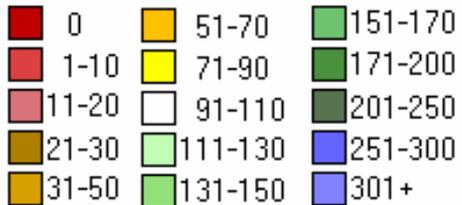


Produced by the Colorado Climate Center utilizing Snotel, NWS, CoCoRaHS and CoAgMet* Preliminary Precipitation Data
 Analysis: Inverse Distance Weighting
 *Summer only

PRISM Colorado Water Year Departure from Normal Oct 09 – Feb 10



% of Average Precipitation



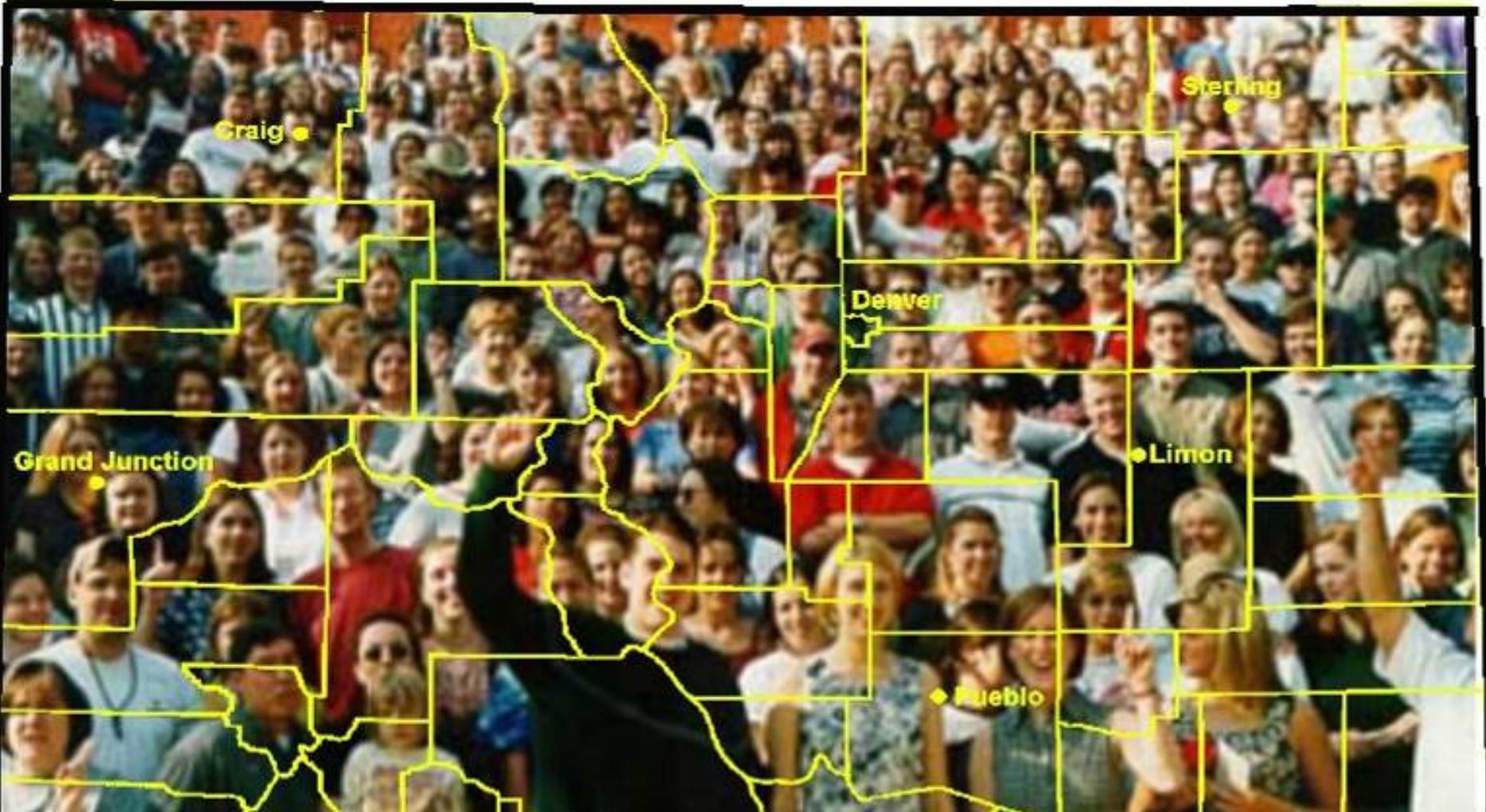
And in my spare time - - - -



I am on a lifelong campaign to recruit people like you to help measure precipitation



How many volunteers do we need?



- Our goal is at least one per square mile over urban/suburban areas.
- One per 36 square miles over rural areas.

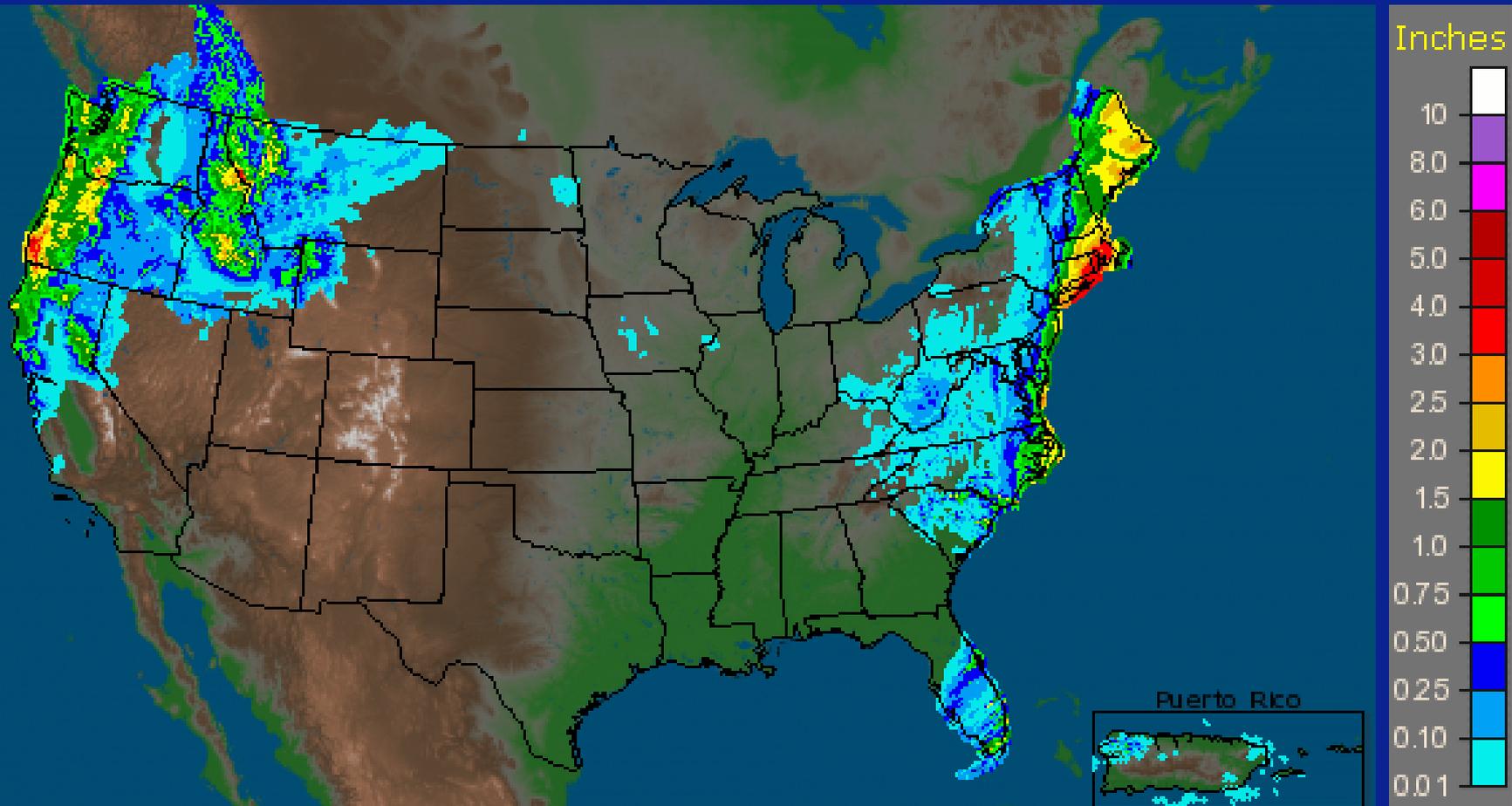
Why ?? Because precipitation is so important, and so variable



The Fort Collins Flood of July 28, 1997

NWS Multi-Sensor Precipitation 1 Day -- utilizes radar, satellite and rain gauges --

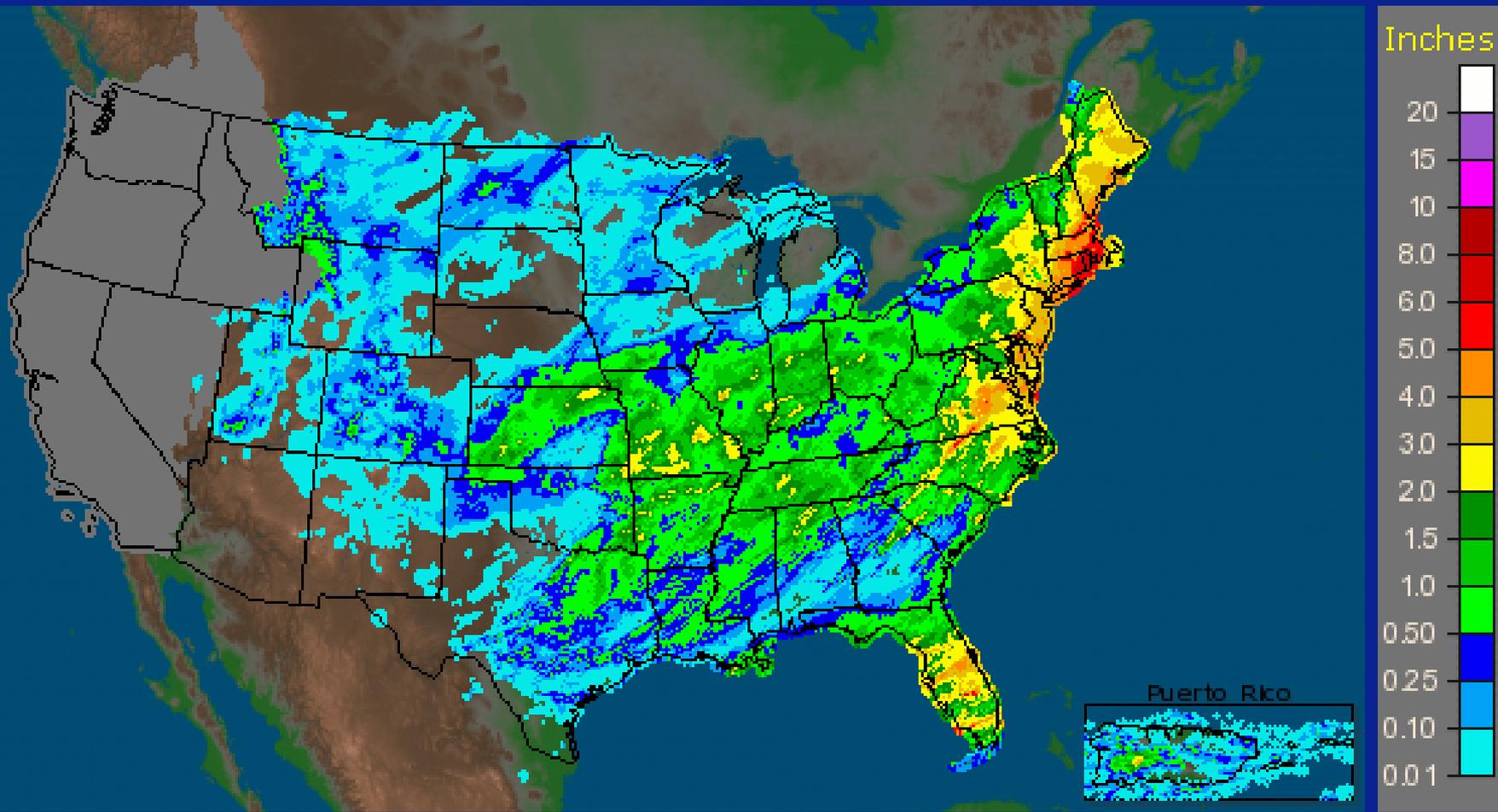
CONUS + Puerto Rico: 3/30/2010 1-Day Observed Precipitation
Valid at 3/30/2010 1200 UTC - Created 3/31/10 10:31 UTC



NWS Multi-Sensor Precipitation 1 Week

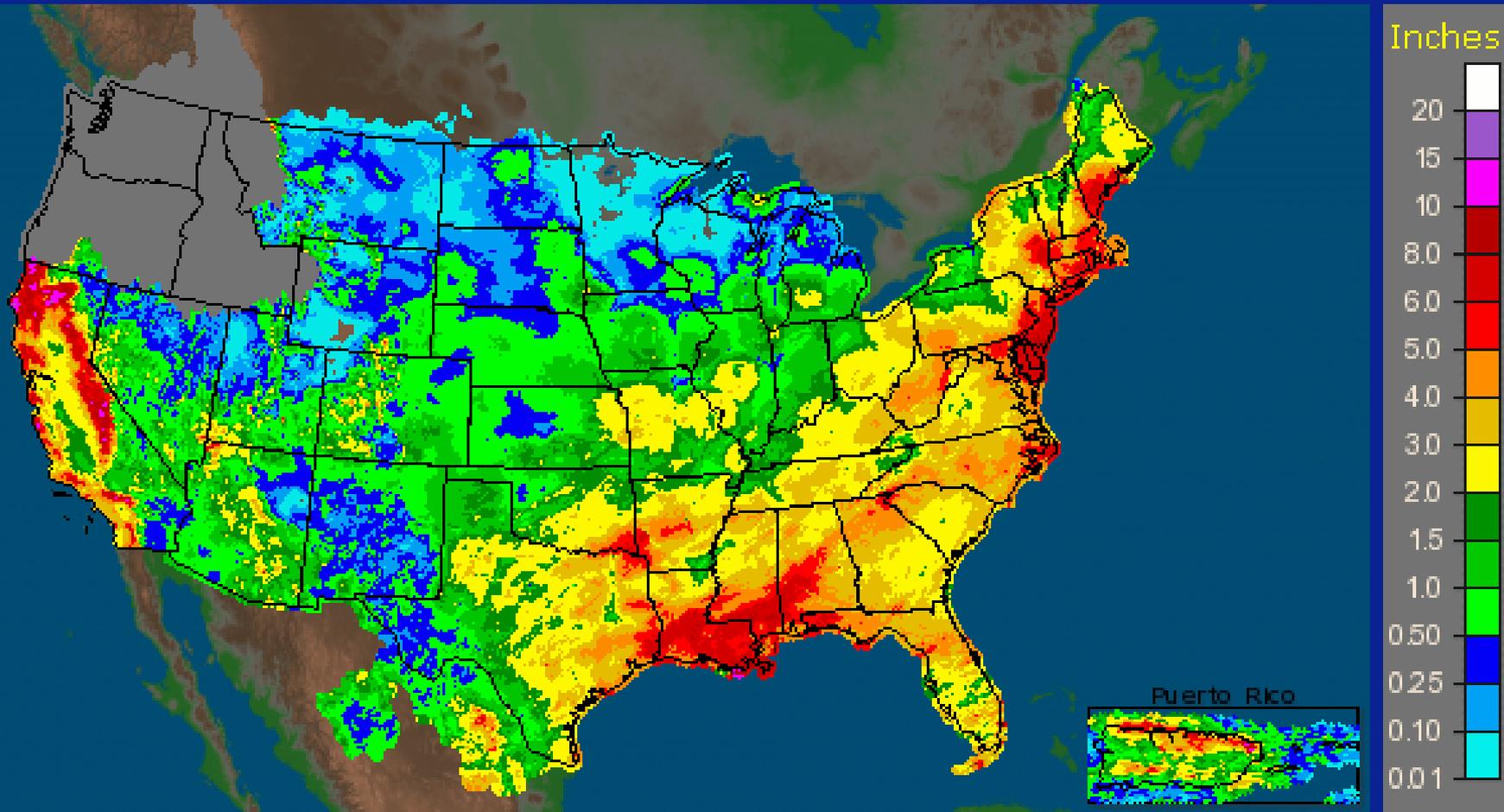
-- CoCoRaHS data are included --

CONUS + Puerto Rico: Current 7-Day Observed Precipitation
Valid at 3/31/2010 1200 UTC - Created 3/31/10 14:38 UTC



NWS Multi-Sensor Precipitation 1 Month February 2010

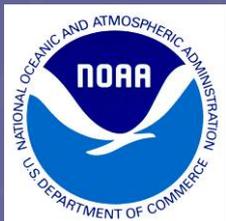
CONUS + Puerto Rico: February, 2010 Monthly Observed Precipitation
Valid at 3/1/2010 1200 UTC - Created 3/1/10 23:35 UTC



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.

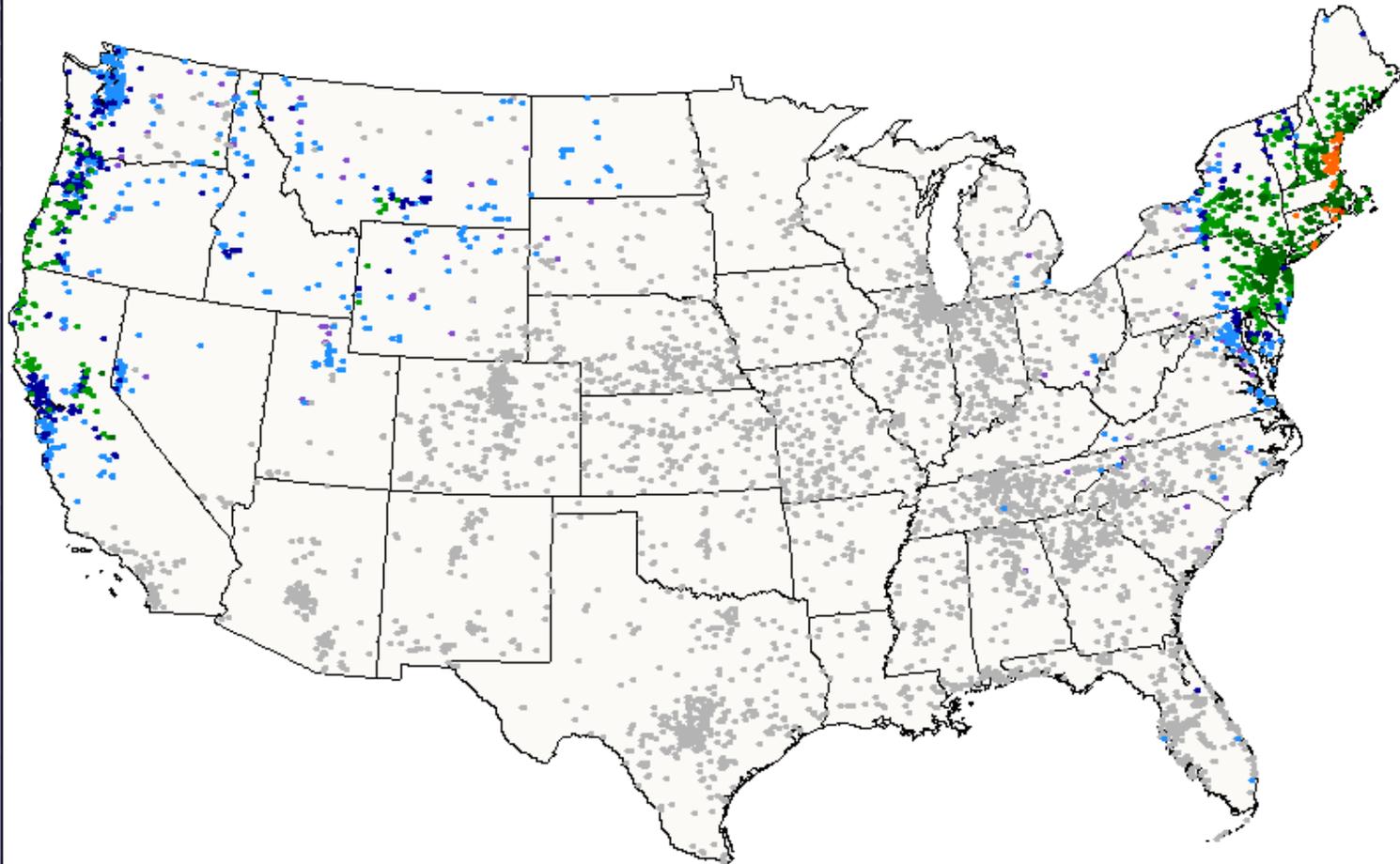
CoCoRaHS National Precipitation Map

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

USA 3/31/2010

0.0 Trace 0.01 - 0.23 0.24 - 0.46 0.47 - 1.15 1.16 - 2.76 2.77 - 4.14 4.15 - 4.61

For 24-hours valid 7 AM MDT March 31, 2010



**Colorado: It's a great place
but we have to be ready for anything**



Photo by Lynn Kral, Loveland, January 2006

Colorado Climate Center

Data and Power Point Presentations available for downloading

<http://ccc.atmos.colostate.edu>

<http://www.stateclimate.org>

