

Funding provided by NOAA
Sectoral Applications Research Project

CLIMATE

Basic Climatology
Colorado Climate Center

Remember These?

- Factor 1: Our Energy Source
- Factor 2: Revolution & Tilt
- Factor 3: Rotation!
- Factor 4: Latitude
- Factor 5: Altitude
- Factor 6: Land & Water are Different

The Influence of Water

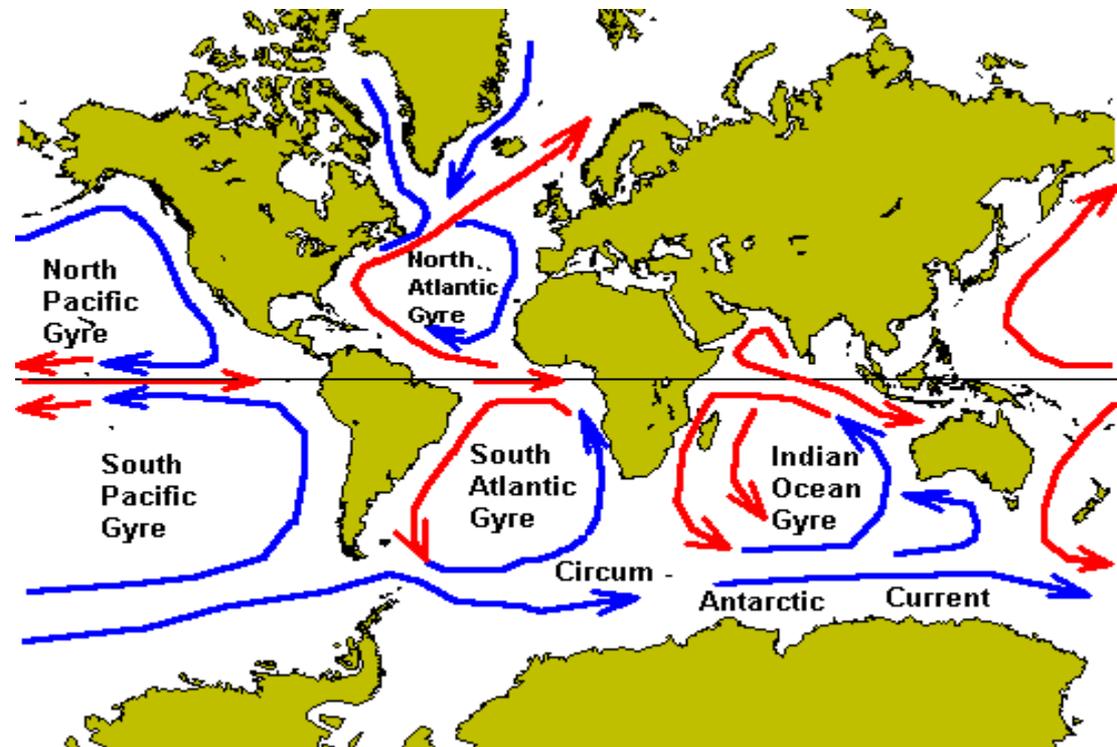
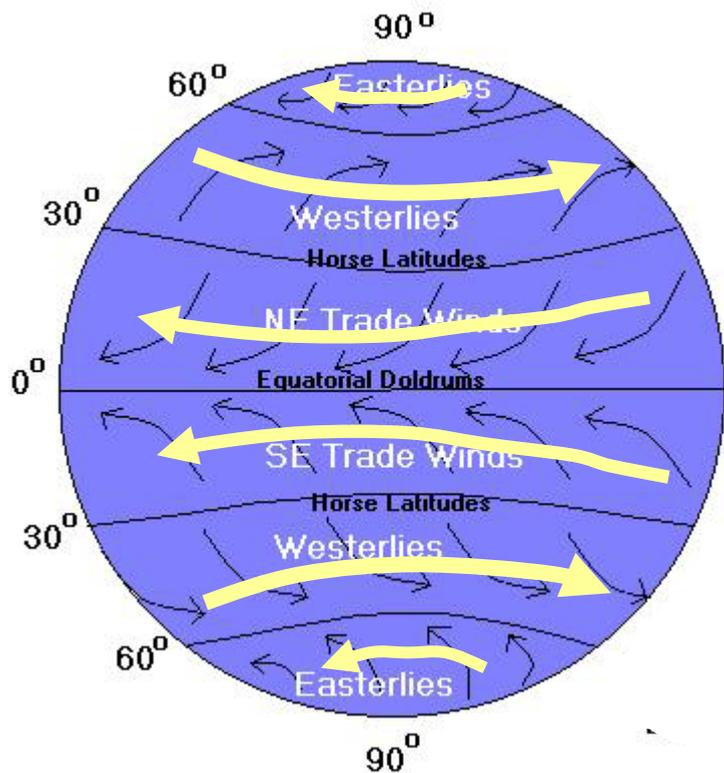
- Average January / July temperatures for three cities at latitude 40N:



Location	January	July	Difference
Chico, CA	47.8	80.4	32.6
Brighton, CO	26.8	72.1	45.3
Columbus, OH	26.0	74.0	48.0

Factors that Influence Climate

- Which side of the ocean you're on!



The winds help stir ocean currents. Generally, western shores get cold water from the poles, eastern shores get warm from the equator.

Climate Zones

A - Tropical Climates

Tropical moist climates extend north and south from the equator to about 15° to 25° latitude. In these climates all months have **average temperatures** greater than 64°F (18°C) and **annual precipitation** greater than 59".



B - Dry Climates

The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation. These climates extend from 20°-35° North and South of the equator and in large continental regions of the mid-latitudes often surrounded by mountains.



C - Moist Subtropical Mid-Latitude Climates

This climate generally has warm and humid summers with mild winters. Its extent is from 30°-50° of latitude mainly on the eastern and western borders of most continents. During the winter, the main weather feature is the mid-latitude cyclone. Convective thunderstorms dominate summer months.



D - Moist Continental Mid-latitude Climates

Moist continental mid-latitude climates have warm to cool summers and cold winters. The location of these climates is poleward of the C climates. The average temperature of the warmest month is greater than 50°F (10°C), while the coldest month is less than -22°F (-30°C). Winters are severe with snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses.



E - Polar Climates

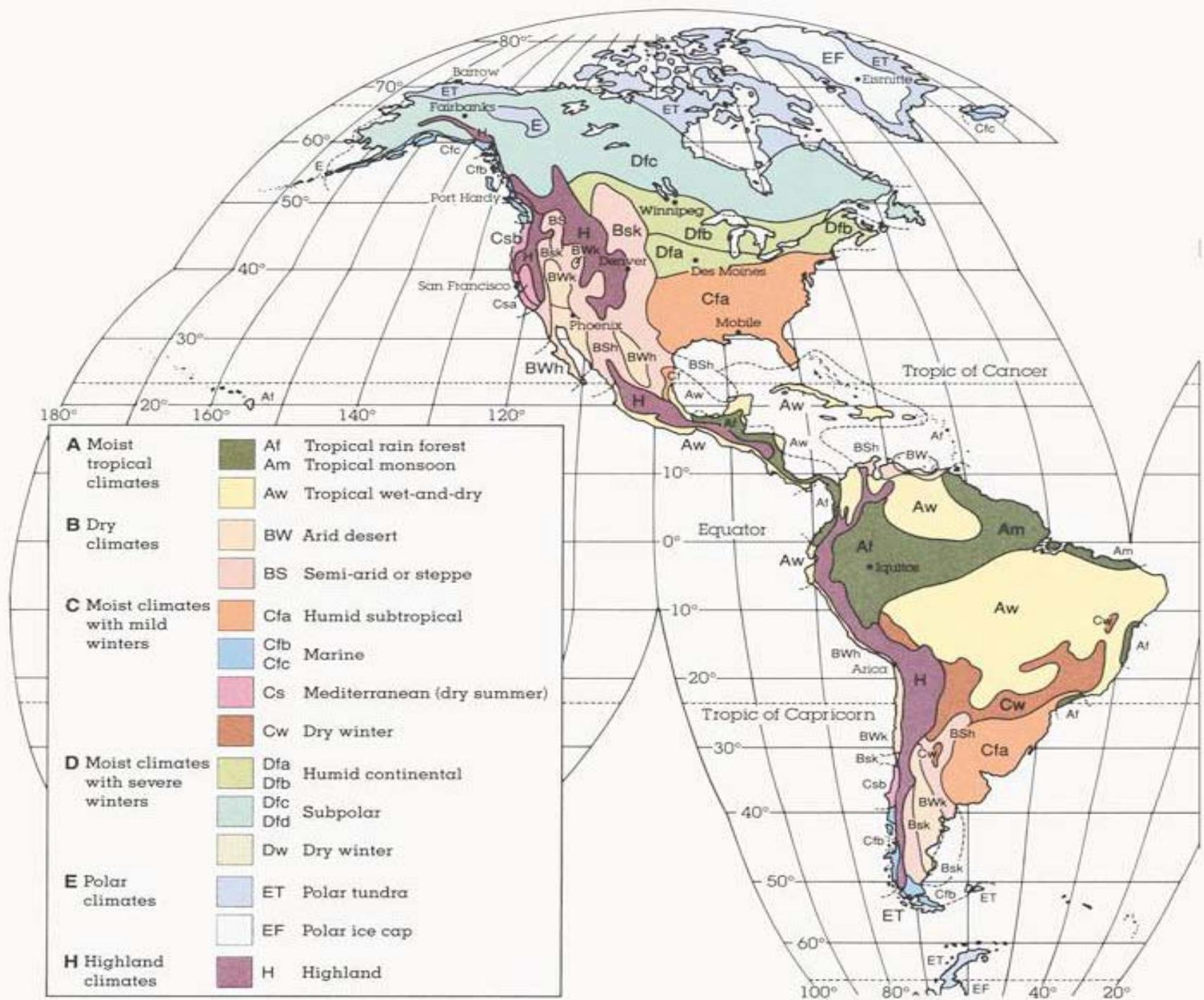
Polar climates have year-round cold temperatures with the warmest month less than 50°F (10°C). Polar climates are found on the northern coastal areas of North America, Europe, Asia, and on the landmasses of Greenland and Antarctica.



H - Highlands

Unique climates based on their elevation. Highland climates occur in mountainous terrain where rapid elevation changes cause rapid climatic changes over short distances.





Limitations to “Naming” Climates

- Implies sharp boundary between climate zones
 - ▣ in reality there is a gradual transition (Colorado is a great example!)
- Relates too strongly to vegetation
 - ▣ useful in areas with little climate data, but it is better to use temp/precip measurements
- Some of the groups (esp. Moist subtropical mid-latitude) are very broad, including what appear to be very different climate types

A WORD ABOUT NORMALS

What is Normal?

- A tool helpful when comparing conditions to the long term
- A 30-year average
- Updated every 10 years
- There are normals for:
 - ▣ Days, months and years
 - ▣ Temperature, rainfall, snowfall, and more!

September Rainfall: Fort Collins

1971	3.55"	1976	1.94"	1981	1.20"	1986	0.74"	1991	0.85"	1996	1.34"
1972	0.51"	1977	0.14"	1982	4.06"	1987	0.65"	1992	0.02"	1997	2.06"
1973	1.70"	1978	0.12"	1983	0.28"	1988	1.95"	1993	2.62"	1998	0.78"
1974	1.08"	1979	1.03"	1984	0.80"	1989	2.33"	1994	0.48"	1999	2.46"
1975	0.39"	1980	0.71"	1985	1.37"	1990	1.36"	1995	2.88"	2000	2.66"

The average of all these numbers is 1.40"
– the normal September rainfall at Fort Collins.

The 1st Dirty Secret of Normals:

Normals only tell you the *average* for a particular month, day or year.
They don't tell you anything about natural variability!

All Normals Work the Same Way

- Fort Collins'...
 - Normal September Rainfall: 1.40"
 - Normal September Temperature: 61.0 degrees
 - Normal September High: 75.3 degrees
 - Normal "First Freeze of Fall": October 2

- *All of these are based on 30 numbers recorded between 1971-2000!*

Normal vs. “supposed to”

- A normal is just an average!
- It doesn't mean “supposed to”
- It's not “supposed to” rain 1.40” at FTC in September
- It doesn't “usually” rain 1.40” at FTC in September
- It has *never* rained exactly 1.40” at FTC during *any* September dating back to 1889

The 2nd Dirty Secret of Normals:

For rainfall, most months are below-normal!

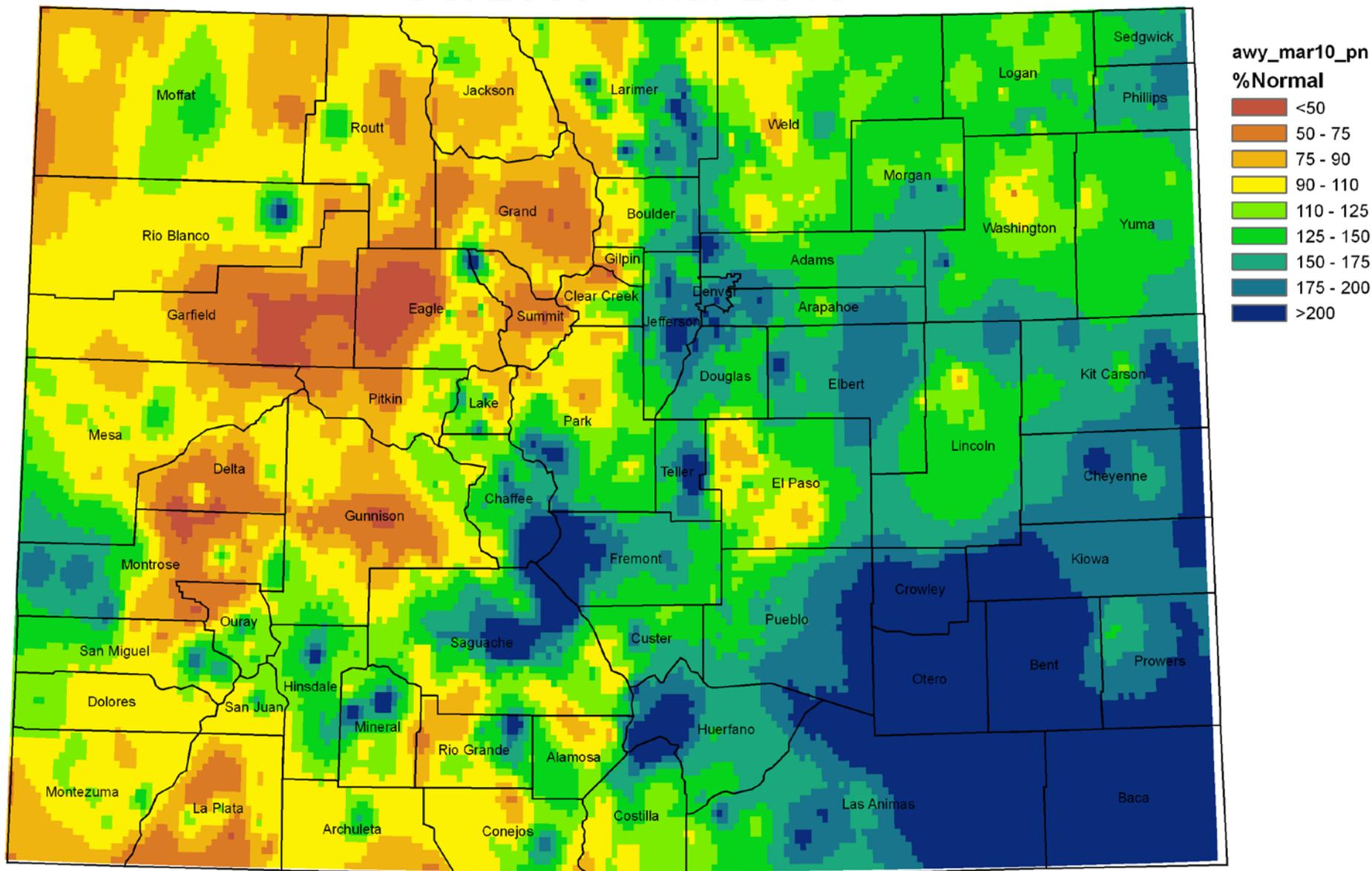
Normal vs. “Supposed To”

- For the sake of the developers of this material, we will leave this example in 😊
- From 1971-2000, the average OU-OSU score was OU 31, OSU 14.
 - ▣ This doesn't mean OU is “supposed to” win 31-14 each following year.
 - ▣ OU *never* won 31-14!
 - ▣ In 2001, OSU won 16-13.
 - ▣ Each year's score (*individual event*) was decided by factors other than the 30-year “normal”

So, what's my point?

- In Colorado, and in much of the U.S., climate values are *highly variable*.
- Large variability makes “supposed to”, “usually” and even the word “about” pretty meaningless on a month-to-month basis.
- However, for *longer-term* rainfall (seasonal, annual, and beyond), departures from “normal” mean more.

Water Year 2010 Precipitation as Percentage of Normal Oct 2009 - Mar 2010



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

*Summer only

So, why have normals?

- People adjust their practices (ag, water resources, etc.) based on recent history
- Normals are exactly that: recent history
 - ▣ About a generation of history, to be exact
- Normals are a good diagnostic tool to put events in perspective
- Normals are a *great* planning tool (again: agriculture, water resources, etc.)



COLORADO'S CLIMATE

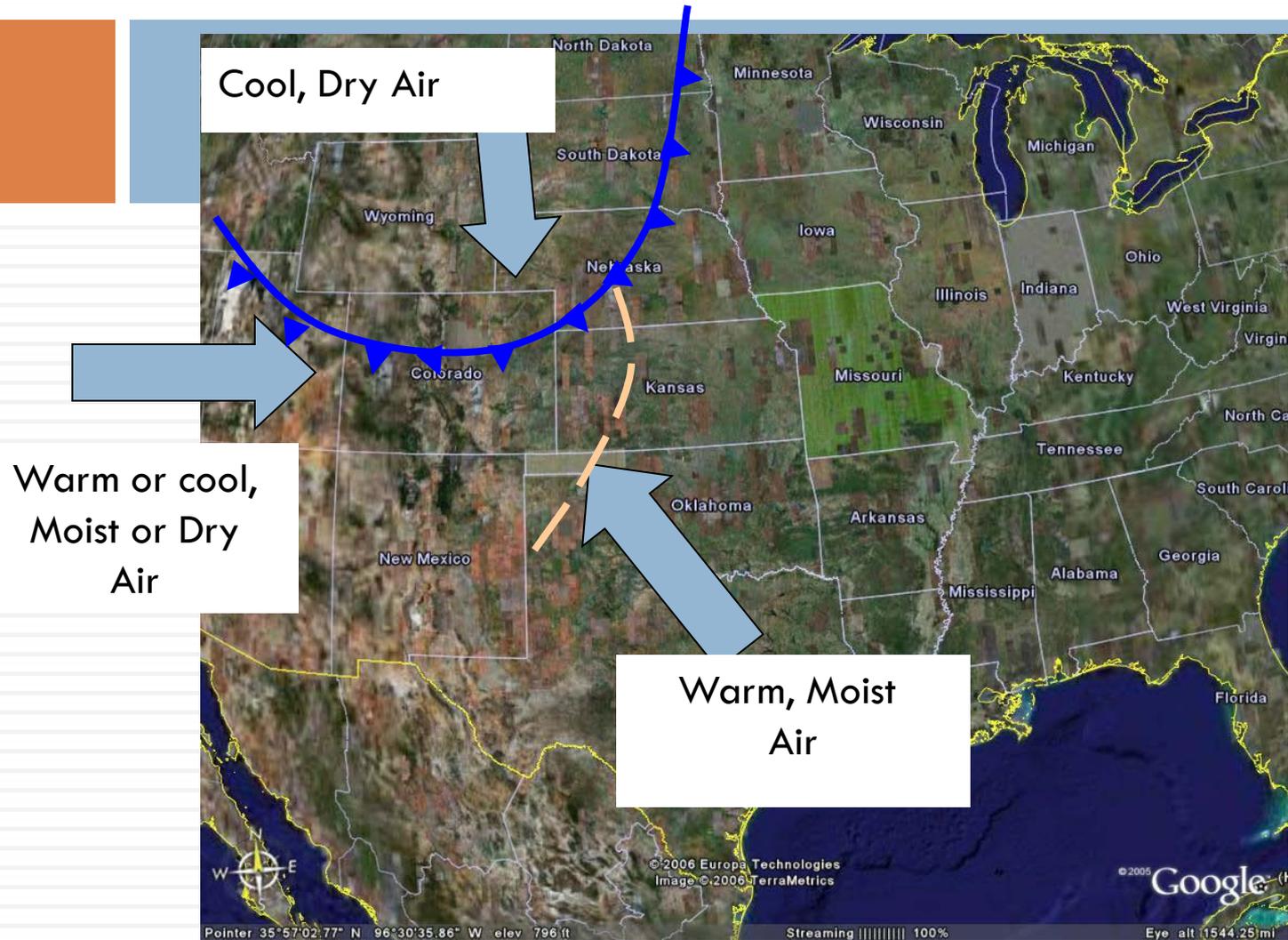
Let's Talk About Our Climate!



What's special about Colorado's Climate?

- ❑ High elevation (highest state in the Union – by far)
- ❑ Mid-Latitude location (lively seasonal changes)
- ❑ Interior Continental Location far from atmospheric moisture sources
- ❑ Complex Mountain topography

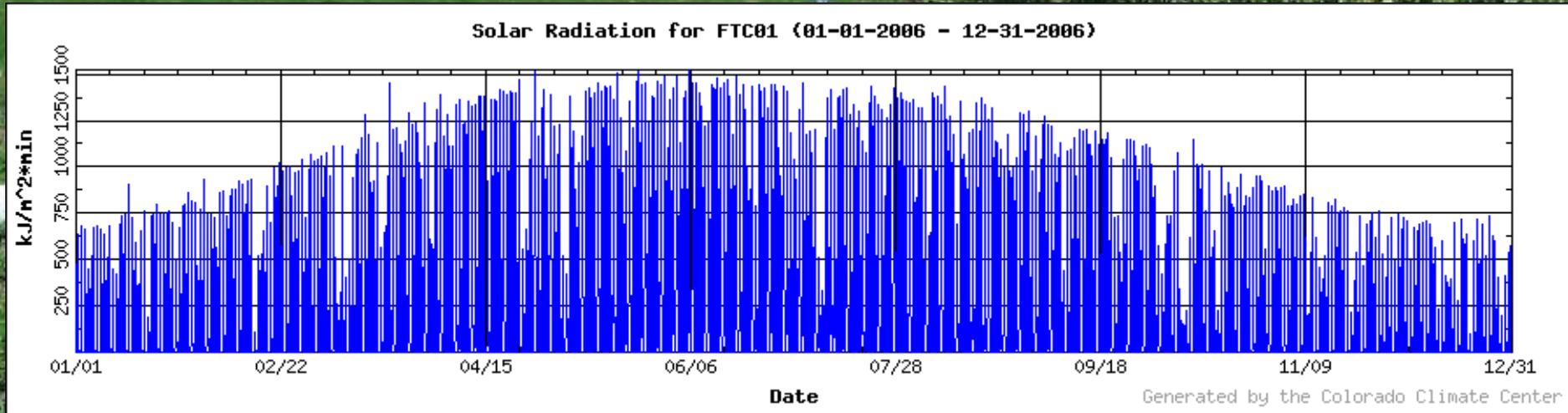
We're caught in the middle



The Result?



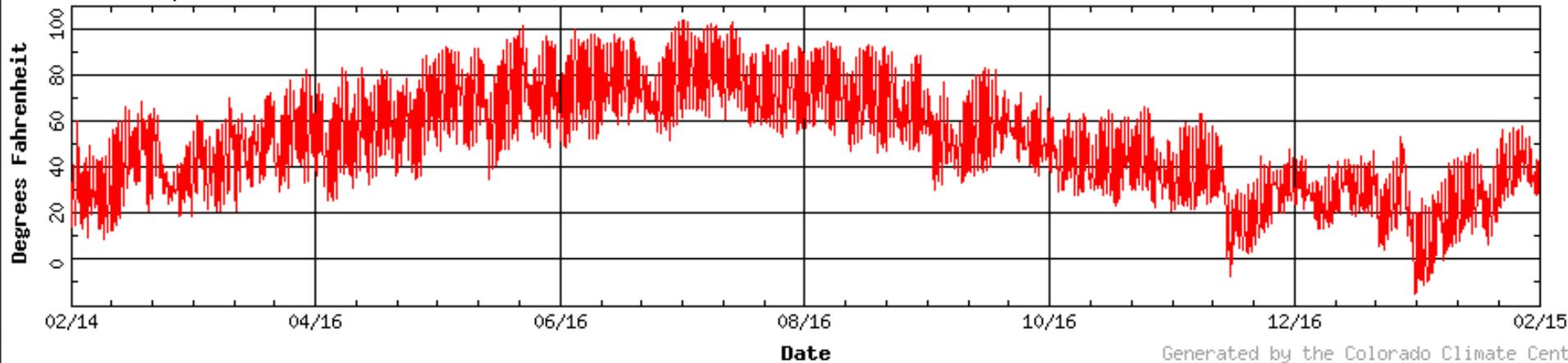
Generous sunshine and low humidity,
i.e. people like it here



Large Seasonal Temperature Variations

Fruita, Colo.

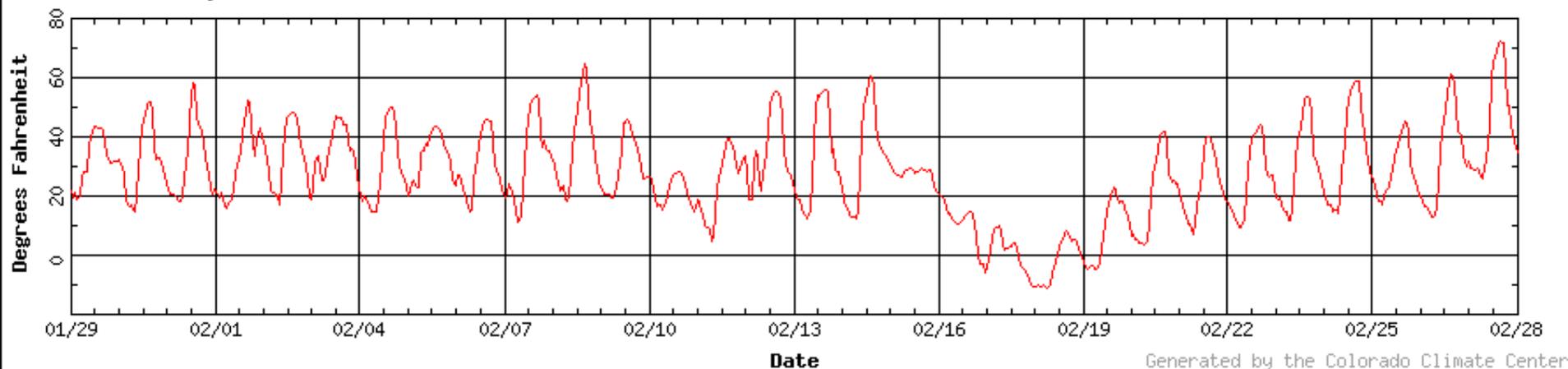
Temperature for FRT02 (02-14-2006 - 02-15-2007)



Large diurnal temperature ranges and rapid changes

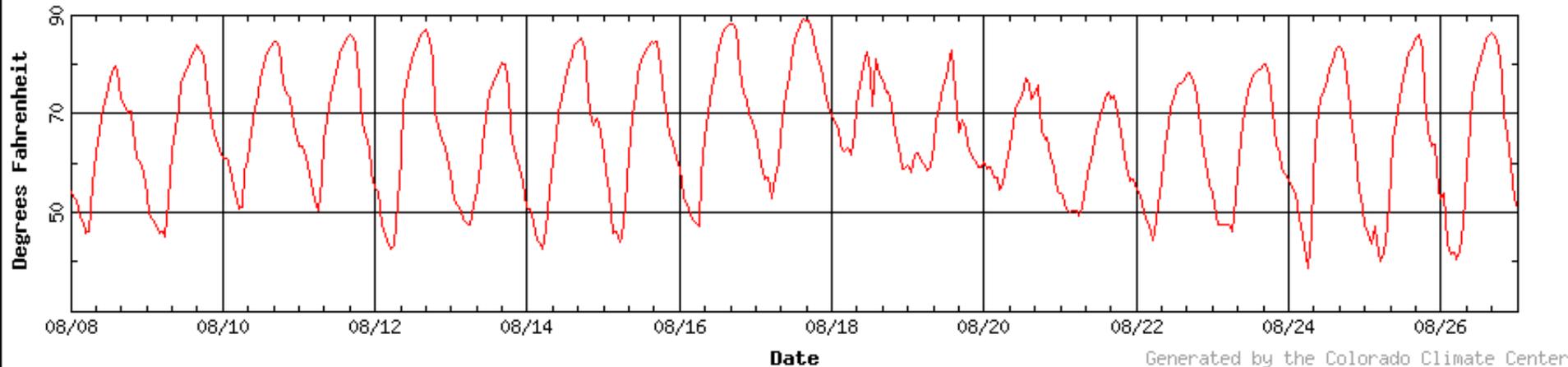
Kersey, Colo.

Temperature for KSY01 (01-29-2006 - 02-28-2006)



Blanca, Colo.

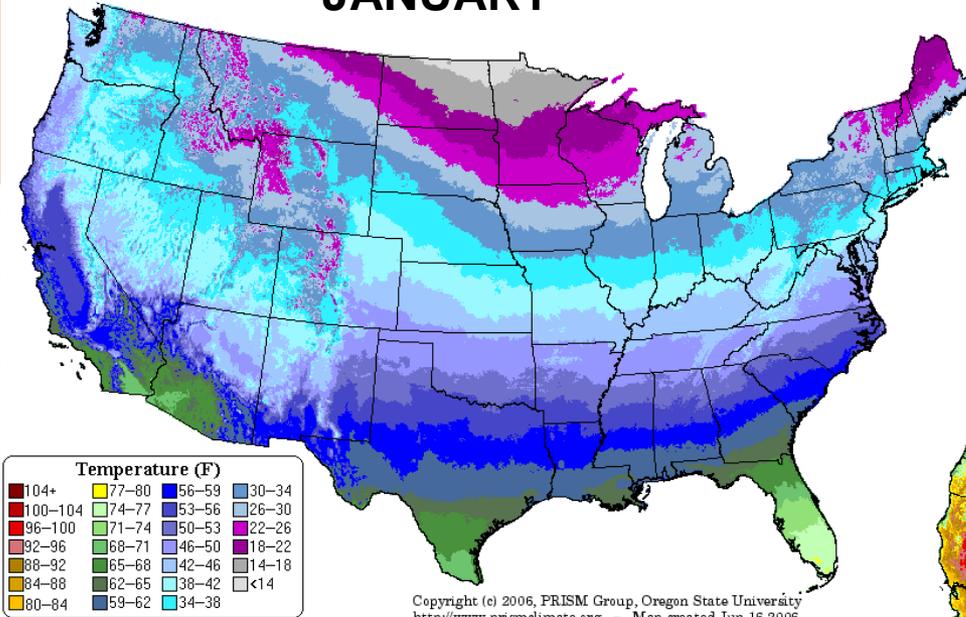
Temperature for BLA01 (08-08-2002 - 08-27-2002)



Complex patterns due to our topography

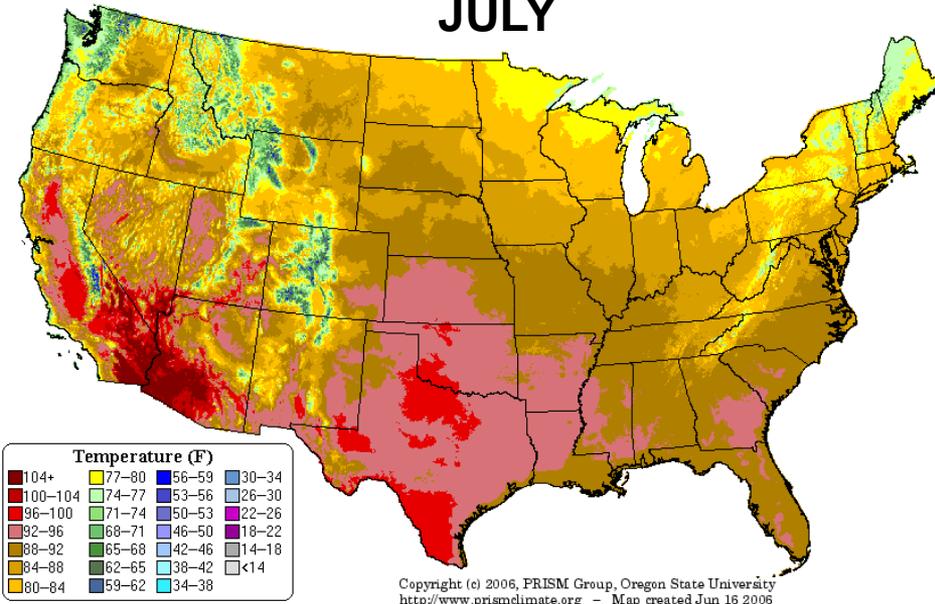
Maximum Temperature: January Climatology (1971–2000)

JANUARY



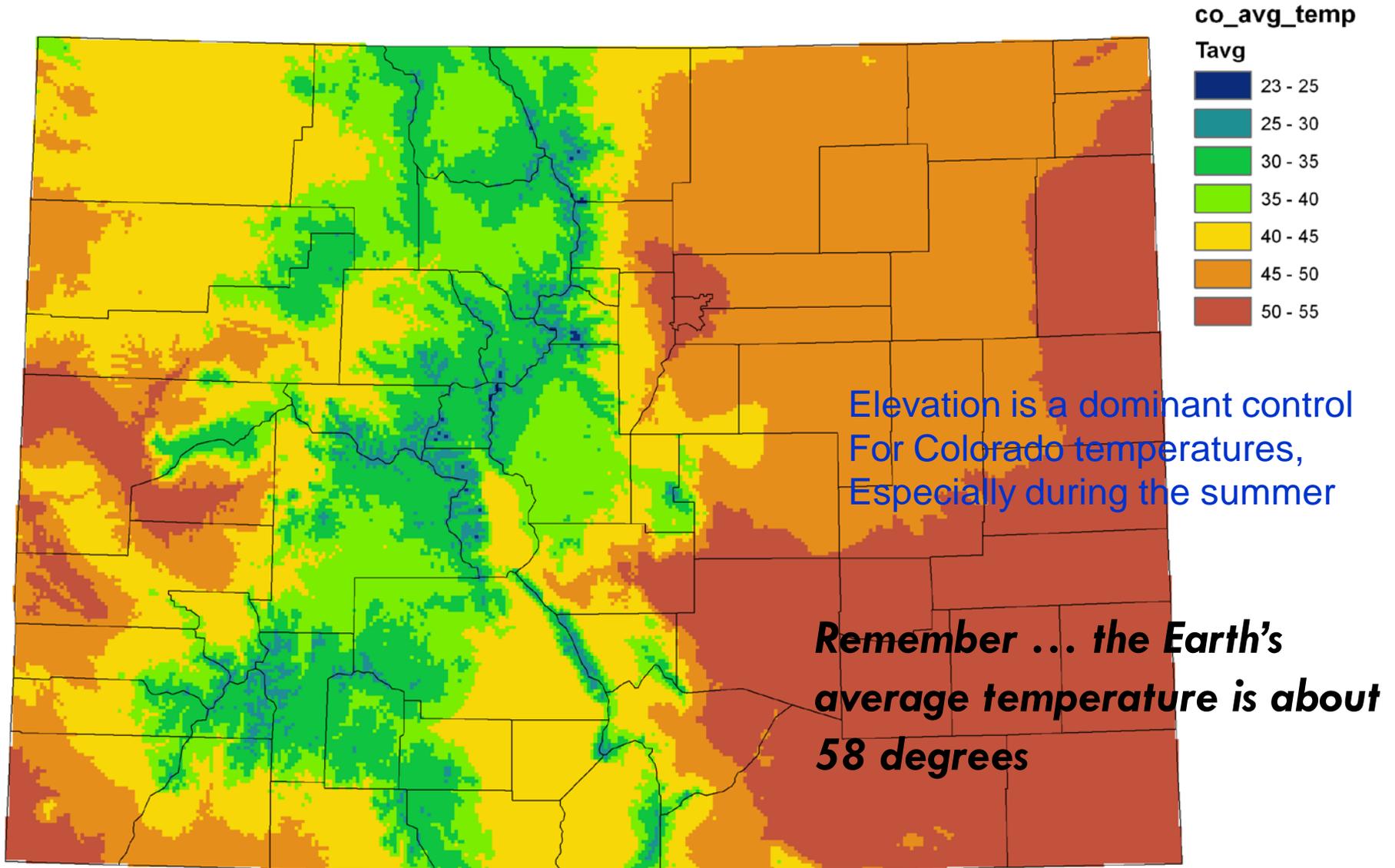
Maximum Temperature: July Climatology (1971–2000)

JULY



Colorado Average Annual Temperature (F)

1971-2000



Data from PRISM Group at Oregon State University

**Frequent but highly variable
precipitation
(for every “upslope,”
there’s a “downslope”)**

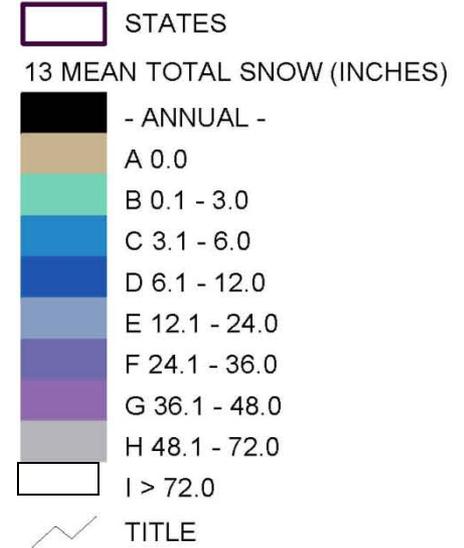
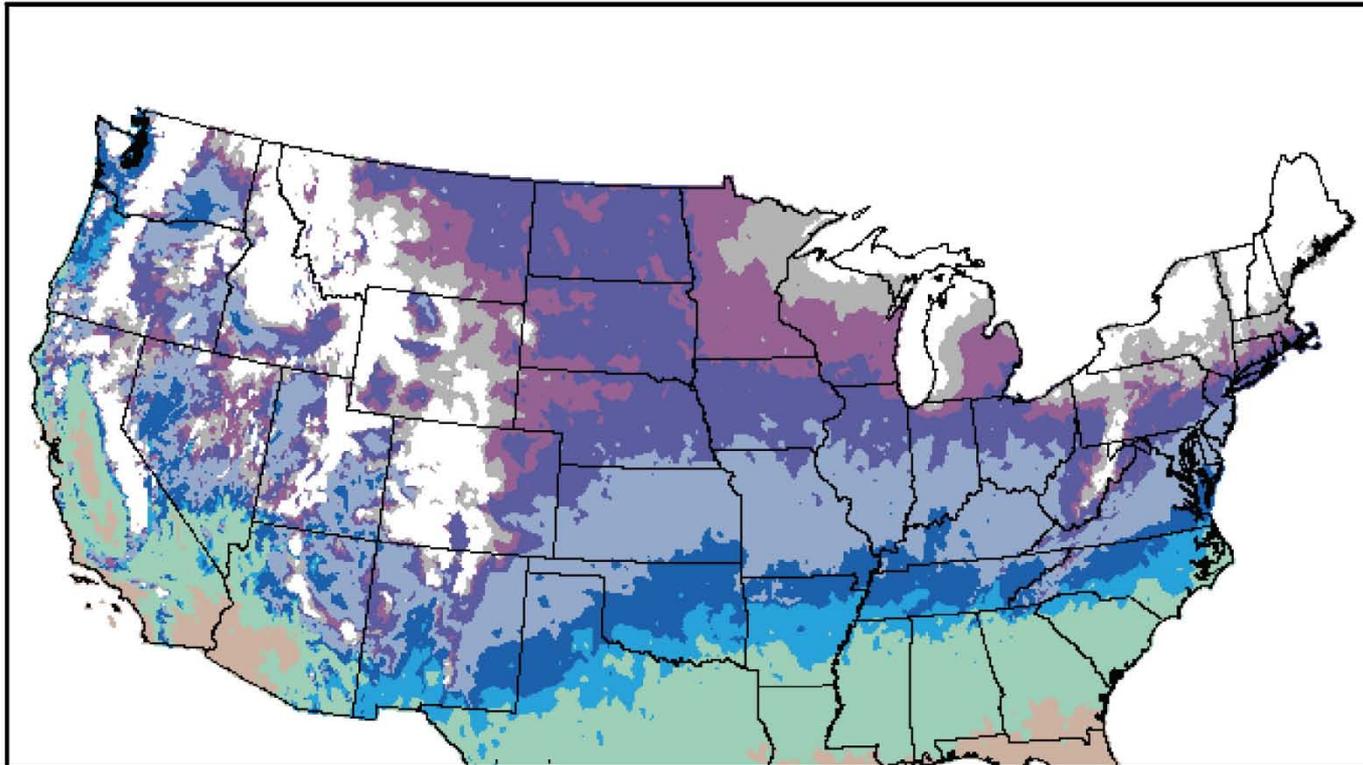


Photo by Wendy Ryan

**Lots of Snow,
sometimes and some places**

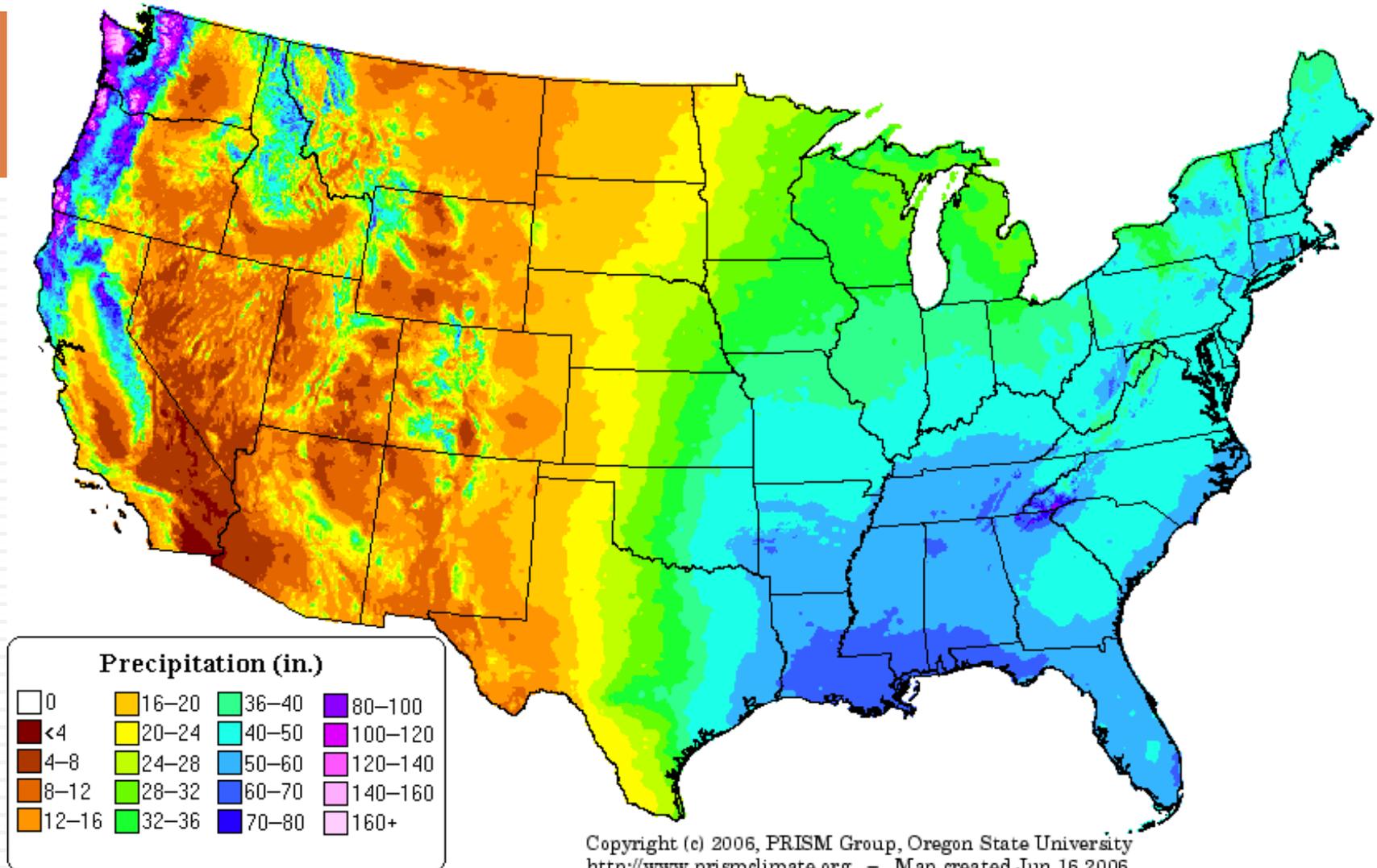


National Annual Average Snowfall



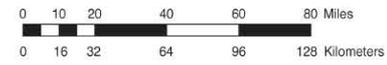
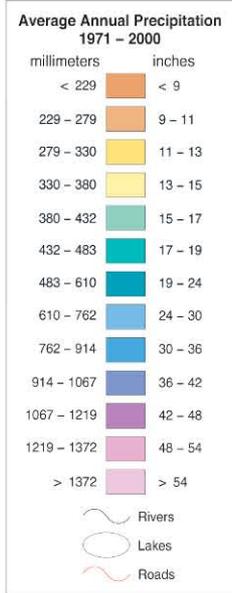
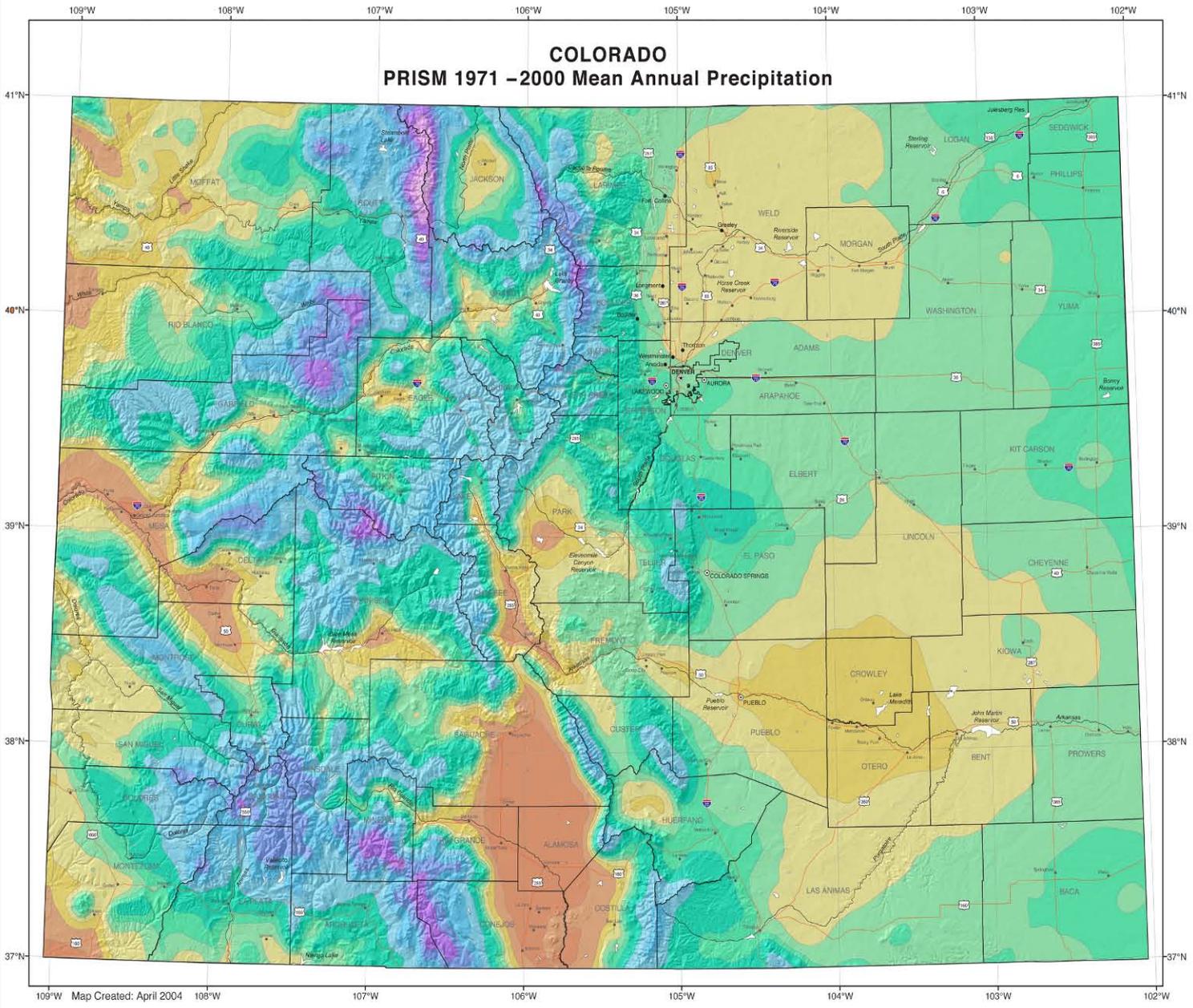
Where we fit in the national picture

Precipitation: Annual Climatology (1971–2000)



COLORADO

PRISM 1971 – 2000 Mean Annual Precipitation

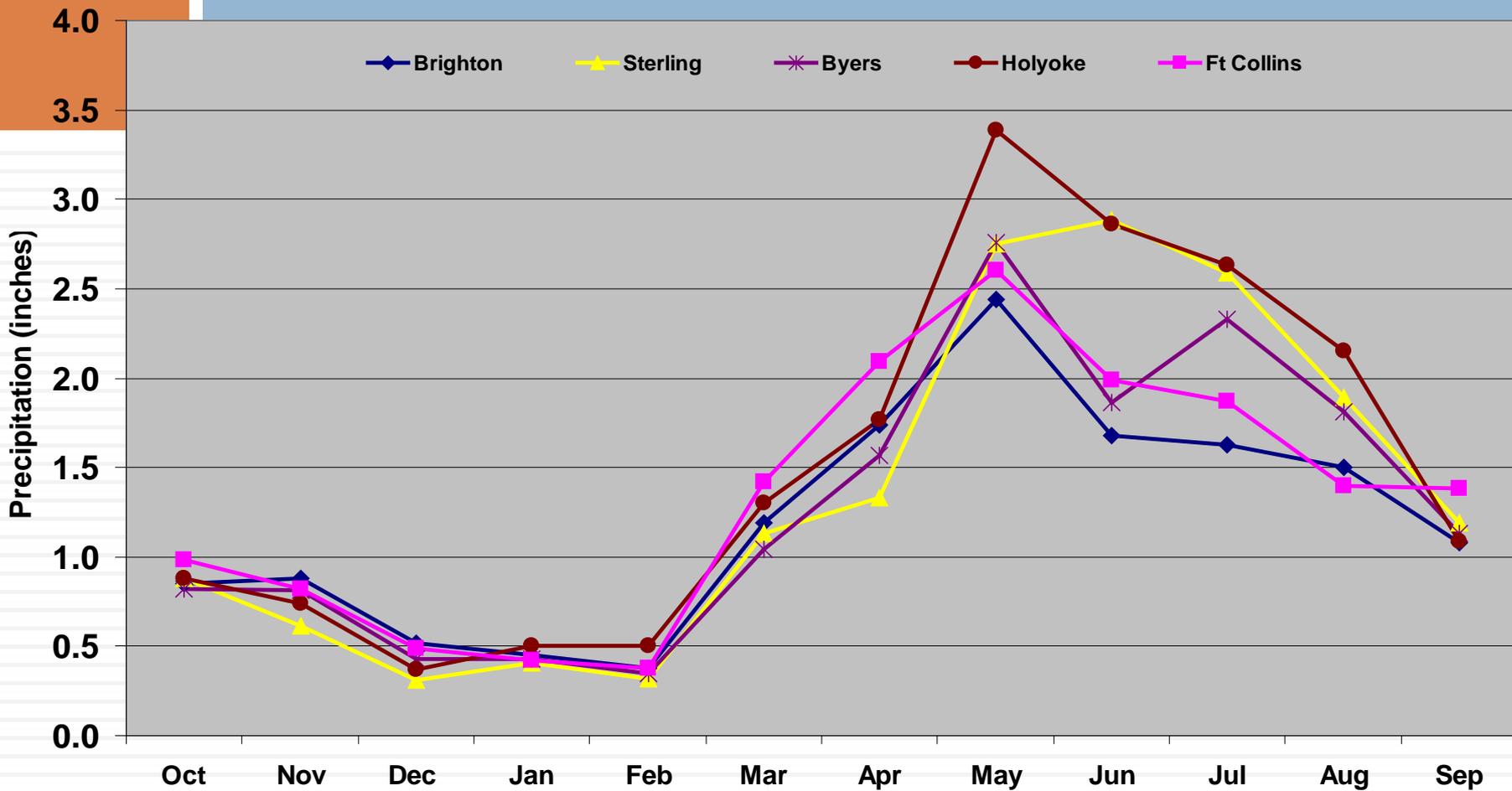


Map prepared with the PRISM climate modeling system by the Spatial Climate Analysis Service, Oregon State University.
<http://www.ocs.orst.edu/prism> Copyright (c) 2004, OSU SCAS



Highly seasonal precipitation patterns with geographic diversity in “seasonality”

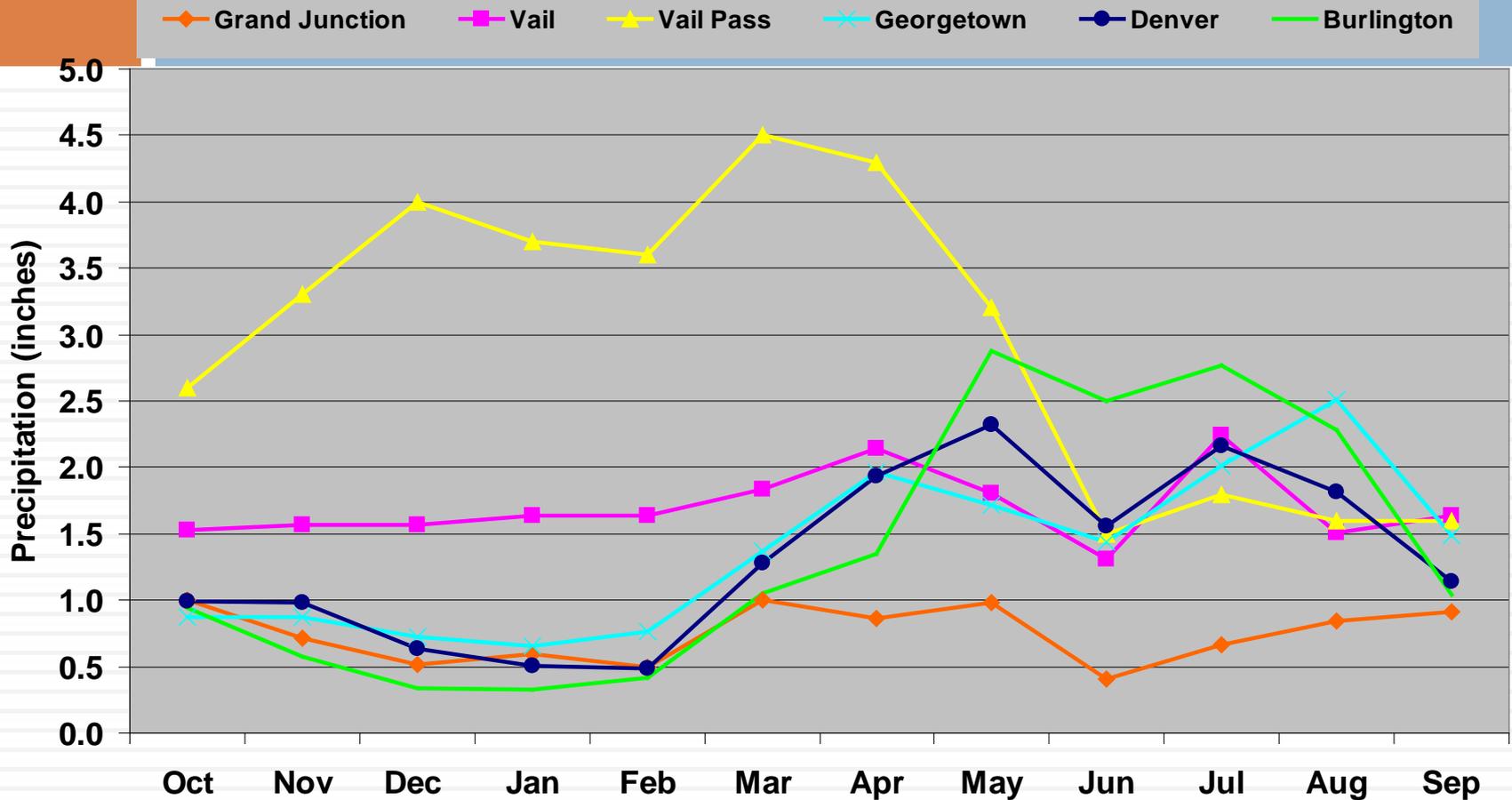
Average Precipitation Selected NE Colorado Locations



Seasonal Precipitation Averages

I-70 Transect

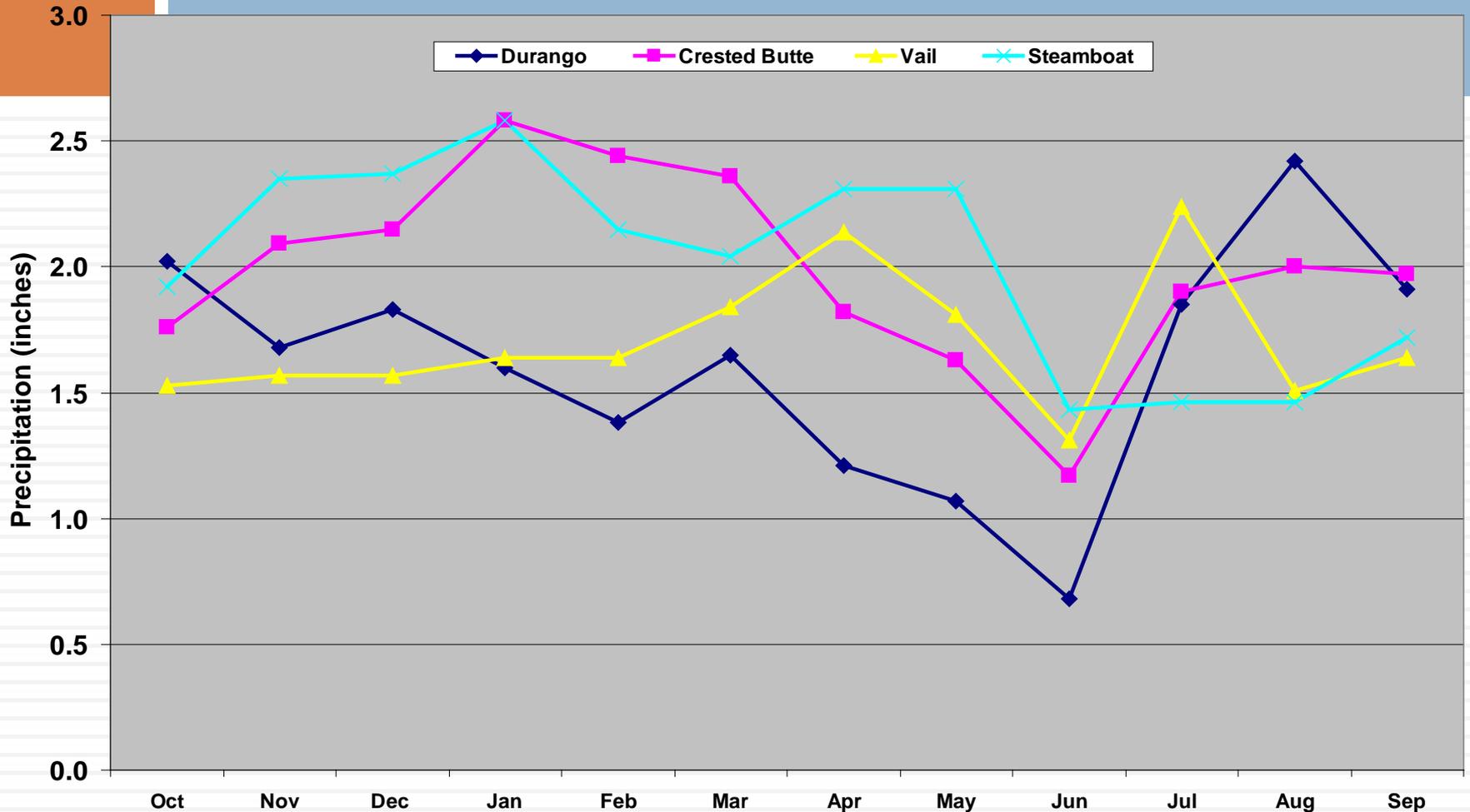
Water Year Average Precipitation for Selected Stations



Seasonal Precipitation Averages

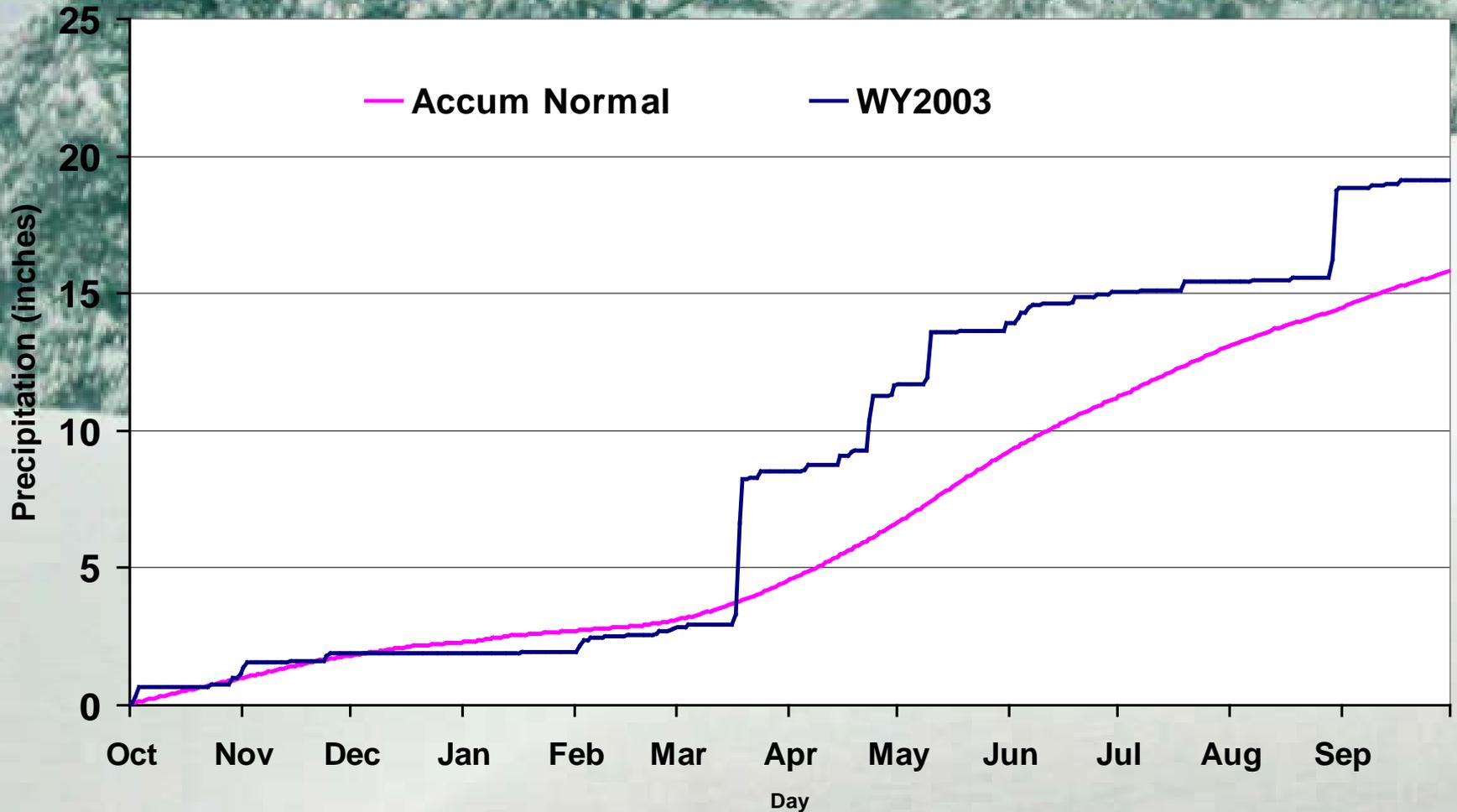
North-South Transect

North-South Transect Water Year Precipitation Averages



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

Fort Collins Daily Accumulated Precipitation

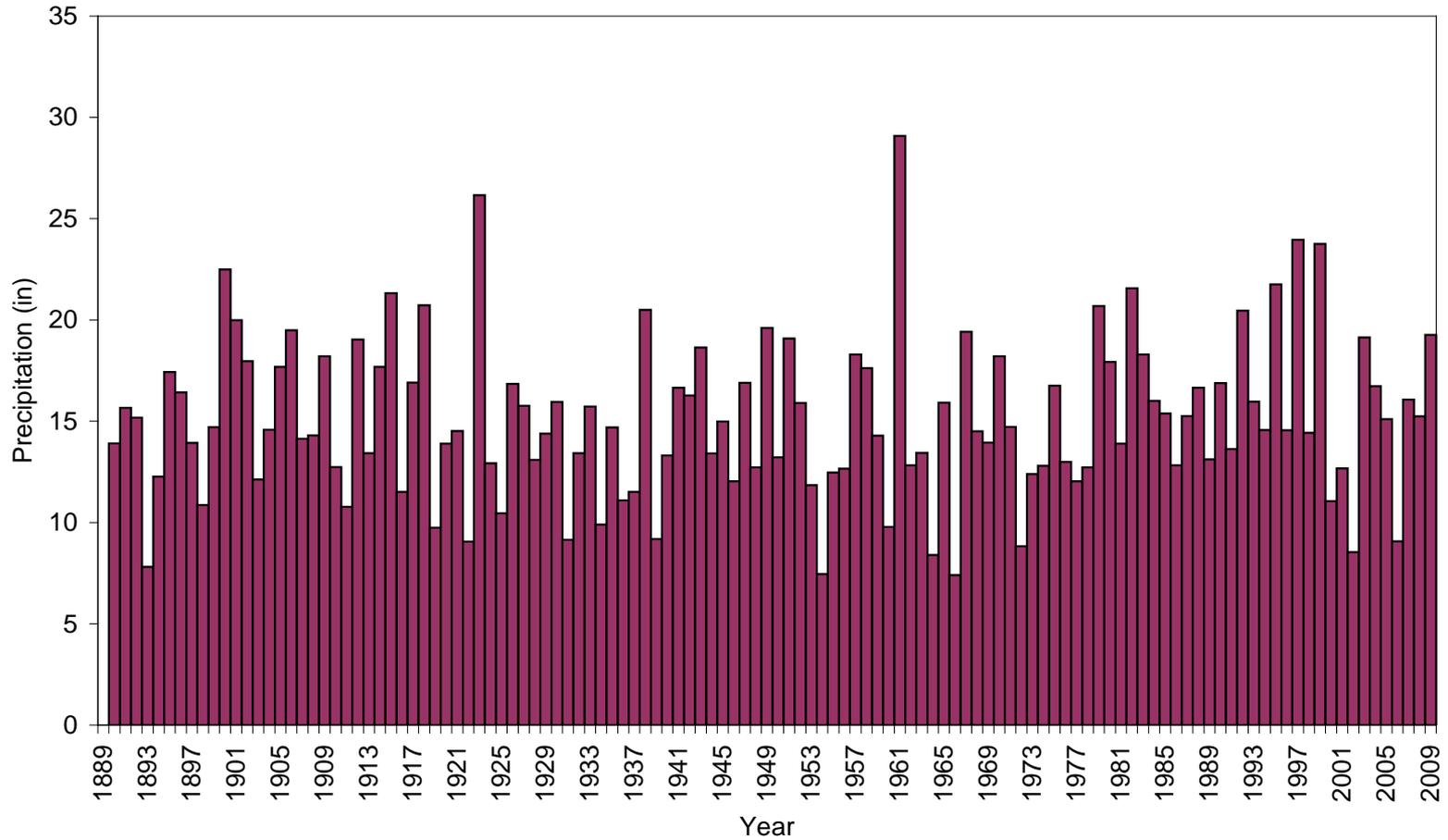


Large Year-to-Year Variations in Precipitation



Fort Collins Water Year Precipitation

Fort Collins, CO Water Year Precipitation (in)



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



Photo by Lynn Kral, Loveland, January 2006

Colorado Climate Hazards

- Winter Storms

March 2003 Snow Storm aftermath in Fort Collins



Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche



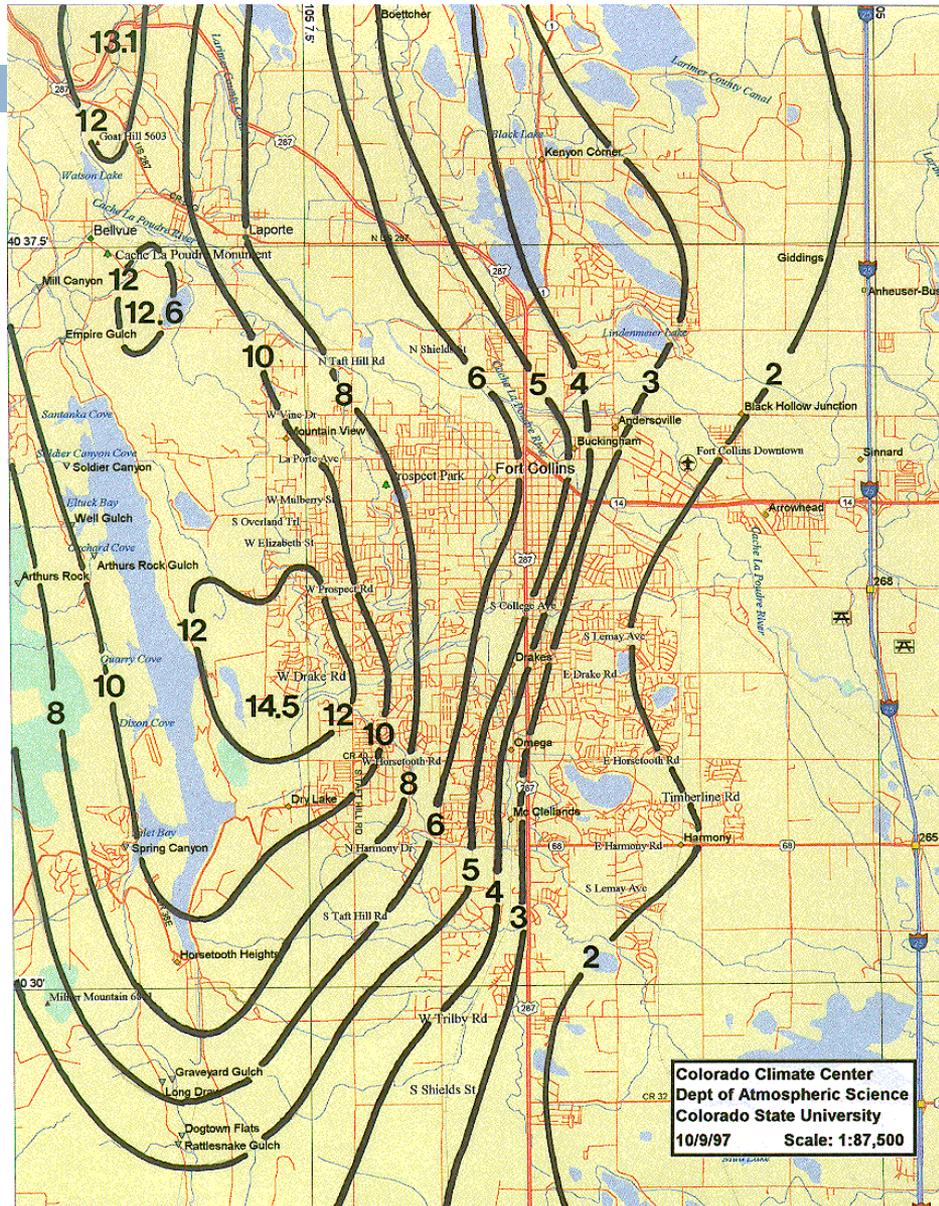
Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods

**Fort Collins Flood
July 28, 1997**

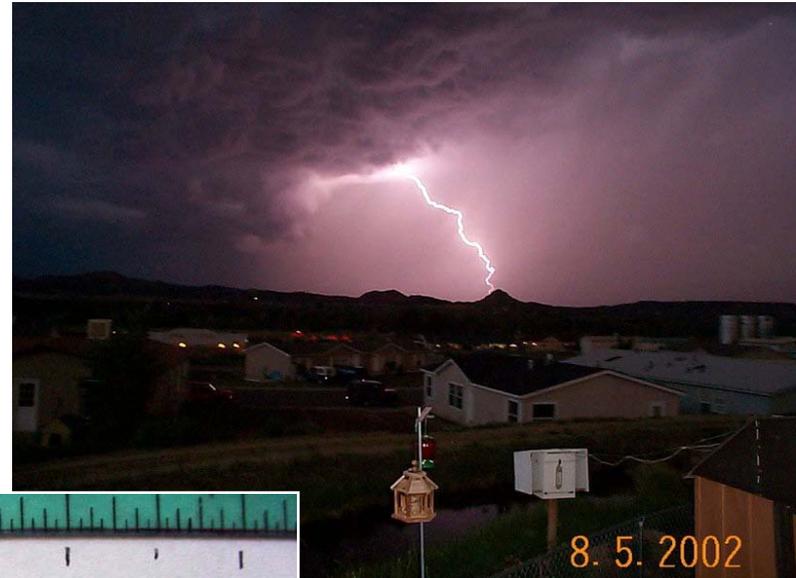


Fort Collins Flood July 28, 1997



Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms
(winds, **hail**, lightning)



Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms (winds, hail, lightning)
- ❑ Tornadoes



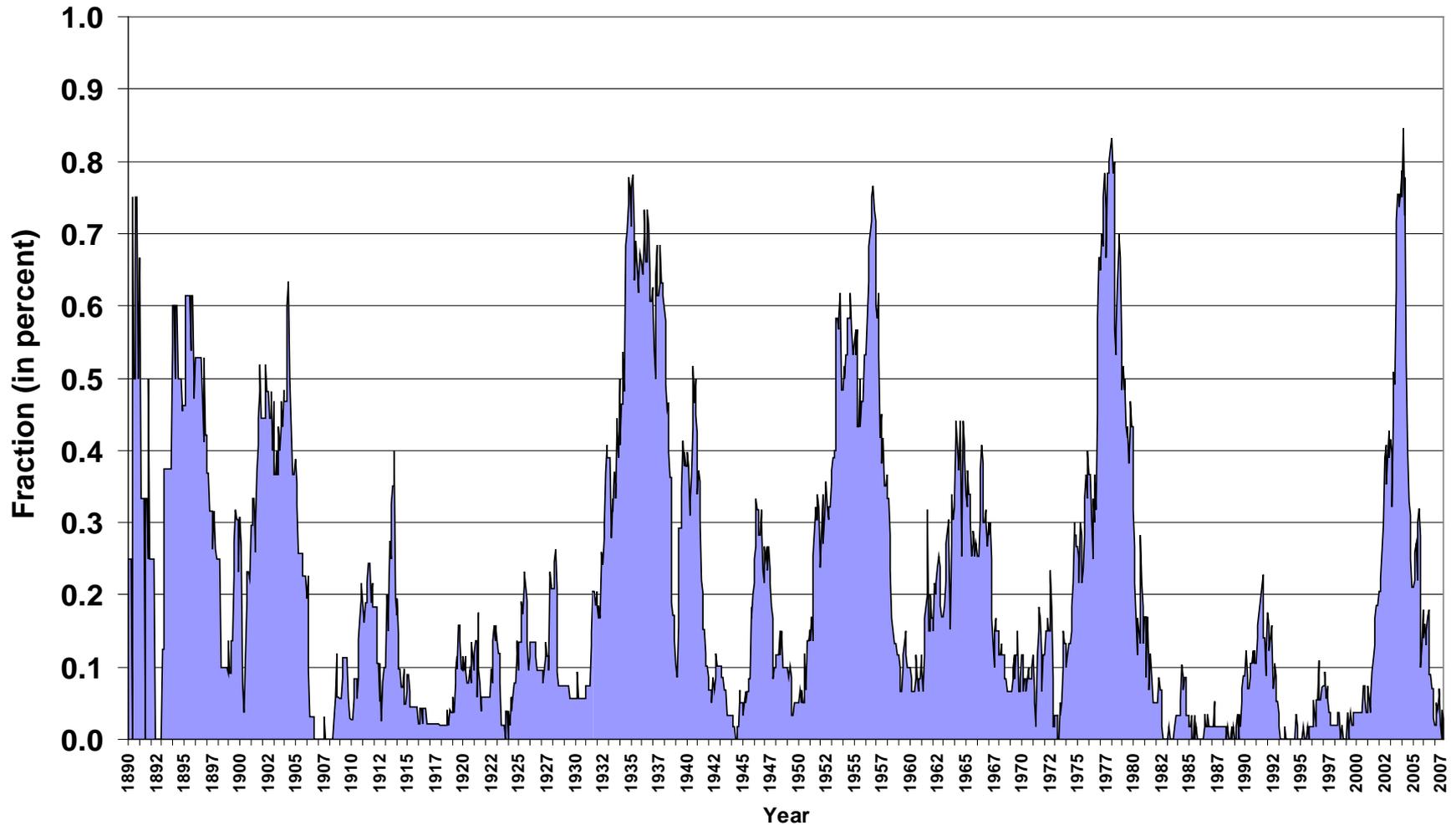
Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms (winds, hail, lightning)
- ❑ Tornadoes
- ❑ Drought



48-Month SPI

Fraction of Colorado in Drought Based on 48 month SPI (1890 - November 2007)



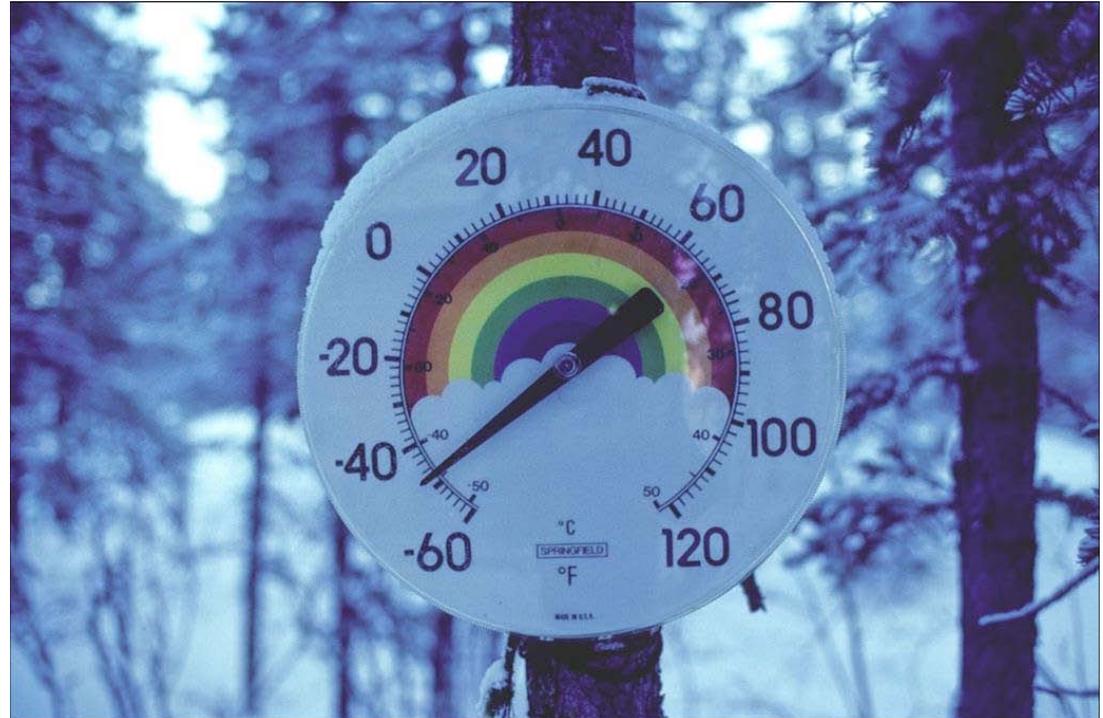
Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms (winds, hail, lightning)
- ❑ Tornadoes
- ❑ Drought
- ❑ Wildfires



Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms (winds, hail, lightning)
- ❑ Tornados
- ❑ Drought
- ❑ Wildfires
- ❑ Extreme Cold



Colorado Climate Hazards

- ❑ Winter Storms
- ❑ Avalanche
- ❑ Flash Floods
- ❑ Severe Storms (winds, hail, lightning)
- ❑ Tornadoes
- ❑ Drought
- ❑ Wildfires
- ❑ Extreme Cold
- ❑ Expansive Soils



But all of that...



Photo Credit: Colorado Climate Center

...makes **THIS** essential!

Good news – It's Break Time

