First -- A short background

- In 1973 the federal government abolished the “State Climatologist” program nationwide leaving Colorado without
- Later that same year, Colorado re-established the State Climate program with support through the Colorado Agricultural Experiment Station at Colorado State University.
- Tom McKee hired in 1974 as State Climatologist
Our Mission

- The Colorado Climate Center at CSU provides valuable climate expertise to the residents of the state through its threefold program of:
  1) **Climate Monitoring** (data acquisition, analysis, and archiving),
  2) **Climate Research**
  3) **Climate Services** (providing data, analysis, climate education and outreach)
Monitoring our Climate

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

Fort Collins CSU Historic Weather Station
Continuous monitoring since the 1880s
Additional background and History

We’ve been tracking climate variations and trends in Colorado longer than you may realize.
Systematic weather data collection began in Colorado in the 1870s and 1880s.

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**WAR DEPARTMENT.**  
**SIGNAL SERVICE, U.S. ARMY.**  
**DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE.**

**METEOROLOGICAL RECORD for the Week ending Jan. 25th, 1871 at Denver, Col.**

<table>
<thead>
<tr>
<th>Date of Observation</th>
<th>Time of Observation</th>
<th>Height of Barometer</th>
<th>Height of Thermometer (double scale)</th>
<th>Reduced Barometer</th>
<th>Thermometer (open air)</th>
<th>Velocity of wind</th>
<th>Pressure of wind (Pounds per square foot)</th>
<th>Amount of cloud</th>
<th>Direction in which upper clouds move</th>
<th>Rain (or snow) commenced, (Time)</th>
<th>Amount of rain or melted snow</th>
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</thead>
<tbody>
<tr>
<td><strong>Denver November 19-25, 1871</strong></td>
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<td><strong>Wednesday Nov. 22</strong></td>
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<td><strong>Saturday Nov. 25</strong></td>
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</tbody>
</table>

*Remarks:* 
- Light Show
- Snow
- Light Snow
- Light Snow
Weather reports began on Pikes Peak in 1873. Reports were sent by telegraph every few hours. Stories abounded in the national media of the rigors of Colorado Climate.
Prior to the about 1859 Colorado was considered to be a useless part of the “Great American Desert”

By the late 1860s Railroad publicist began promoting Colorado’s delightful climate — bright sunshine, fresh water and lush vegetation — even before the first official weather stations were installed.
By 1885 initial “climatology” of Colorado was taking shape. The semiarid and highly variable nature of Colorado was identified.
In the late 1880s the Colorado State Legislature passed legislation supporting the “Colorado State Weather Service”.

$2,000 was appropriated, and an effort was started immediately to establish improved monitoring.
This “Weather Service” was short lived. In 1890, the U.S. Department of Agriculture took over “climate monitoring and reporting responsibilities”.
By 1890 a robust statewide weather reporting network was in place.
Monitoring has continued ever since – our role has focused on temperature, precipitation, snowpack and other elements affecting water resources.

Many of you have become involved in climate monitoring, too – but from a different perspective.
We traditionally relied on data from the National Weather Service and the USDA Natural Resources Conservation Service.
Example of a traditional National Weather Service “Cooperative” weather station in eastern Colorado

Photo by Christopher Davey
More recently we have deployed our own specialized climate monitoring Networks.
Cup anemometer and wind vane: Wind speed, direction and gusts

Temperature/Humidity sensor in radiation shield

Soil temperatures

Solar panel powers the station

2 m

2 m

5/-15 cm

Pyranometer: Solar radiation

Above all else facing South

Tipping bucket rain gage

Data collection platform (DCP)

CoAgMet

The Colorado Agricultural Meteorological Network
And our own nationwide volunteer precipitation network

CoCoRaHS = Community Collaborative Rain, Hail and Snow Network

http://www.cocorahs.org
What have we learned from over 125 years of continuous climate monitoring?
We Have a Fascinating 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
The Result?
Generous sunshine and low humidity much of the time

People like it here

(the 1870 railroad publicists weren’t lying)
Colorado is a part of the Southwest “Sunbelt” ---- especially southern Colorado

National Renewal Energy Laboratory: www.nrel.gov
Large Seasonal Temperature Variations

Fruita, Colo.

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

Generated by the Colorado Climate Center
Mountain Community Temperatures compared to Front Range cities of Colorado

<table>
<thead>
<tr>
<th>Month</th>
<th>Mean Temperature (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>34</td>
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<tr>
<td>Feb</td>
<td>39</td>
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<td>Mar</td>
<td>42</td>
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<td>Apr</td>
<td>45</td>
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<td>May</td>
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<td>Jun</td>
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<td>Jul</td>
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<td>Oct</td>
<td>48</td>
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<tr>
<td>Nov</td>
<td>39</td>
</tr>
<tr>
<td>Dec</td>
<td>32</td>
</tr>
</tbody>
</table>

- **Steamboat Springs**
- **Fort Collins**
- **Denver**
- **Colorado Springs**
- **Pueblo**
Can you see the difference between southern CA and our part of Colorado?
Complex local variations due to elevation and topography

Usually colder in the mountains!
Nice smooth graphs like this of average monthly temperatures – this is a way of looking at CLIMATE
And this is how daily weather, over time, defines our climate.
Relatively Large Year to Year Variations ("Interannual Variability")

Colorado Statewide Mean Annual Temperature (1895-2010)
Where we fit in the national picture

Thanks to our high elevation and interesting topography, precipitation occurs fairly often. But we’re a long way from primary moisture sources so precipitation is limited and highly variable.
The mountains block and harvest winter moisture (most years) leaving eastern Colorado dry.

Average Precipitation Selected NE Colorado Locations

- Brighten
- Sterling
- Byers
- Holyoke
- Ft Collins

Precipitation (inches) vs. Time (months)
Precipitation patterns in Colorado along I-70
Seasonal patterns differ elsewhere in Colo.

Water Year Average Precipitation for Selected Stations

- Grand Junction
- Vail
- Vail Pass
- Georgetown
- Denver
- Burlington

- Precipitation (inches)
- Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Large Year-to-Year Variations in Precipitation
Denver Water Year Precipitation (1872 - 2011)

- Denver City PPT
- Denver-Stapleton PPT

Precipitation Amount (inches)

Year:
- 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
- 2015
- 2020
In semi-arid parts of the U.S. precipitation may vary by more than 100% from one year to the next.
Most recent 12-month period (Oct 2010- Sept 2011)
2011 is 47th driest (Period of Record 1895-2011)
Colorado Statewide April 1 Snowpack

Time Series of April 1 Snowpack – Tracking Variability and Trends

APRIL 1 SNOWPACK
COLORADO STATEWIDE

Year

Percent of Average

100 95 95 87 87 59 59 74 74 84 84 91 91 93 93 94 94 96 96 99 99 96 96 103 103 107 107 113 113
And like it or not . . . .
Drought Visits Our Area Regularly

Photo by NRCS
Severe and widespread drought is less frequent
But still impacts Colorado on a regular basis
Our severe drought of 2002 was relatively short
In comparison to some past droughts

Fraction of Colorado in Drought
Based on 48 month SPI (SPI < -1)
(1890 - March 2012)

We are already moving into another major drought period
U.S. Drought Status last summer

U.S. Drought Monitor
August 2, 2011
Valid 8 a.m. EDT

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

Drought Impact Types:
- 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, August 4, 2011
Author: Brad Rippey, U.S. Department of Agriculture
What are our climate data telling us about changes in climate in Colorado?
Confidently detecting climatic trends is much more challenging and difficult than determining spatial patterns, seasonal cycles, or year-to-year variations.
Lack of historically consistent long-term climate data make it difficult to draw confident conclusions on climate trends in many areas.
Colorado Mean Winter (DJF) Temperatures

64th Coldest Winter (1895-2011)
Colorado Mean Spring (MAM) Temperatures

41st Warmest Spring
(1895-2011)
Colorado Mean Summer (JJA) Temperatures

3rd Warmest Summer!!!
(1895-2011)
Colorado Mean Autumn (SON) Temperatures

11th Warmest Autumn (1895-2010)
A key feature of the past 20 years has been a general lack of extreme cold temperatures.
Most locations in Colorado show a small to modest upward trend in temperatures.
Colorado Statewide Precipitation History
Large Variations but no particular trends

Most recent 12-month period (Oct 2010- Sept 2011)

2011 is 47th driest (Period of Record 1895-2011)
So, what about this year?
Denver-DIA Daily Maximum and Minimum Temperatures compared to Average (1981-2010)
It will be interesting to see how our water supplies hold out with so little remaining snowpack.
Did you know?? It’s a special year here

2012 Water Celebration

- Please participate in Water 2012 Activities!

- As a part of this statewide “2012 -- Year of Water” celebration, we are encouraging schools, families, individuals – and people like you in Colorado to help us measure and track precipitation. Because “the weather is our source of water”
We are encouraging citizens across the State and Nation to help us measure local precipitation

Photos by H. Reges
CoCoRaHS Daily Precipitation
for 24-hr ending 7 AM Monday, March 27, 2012

All from volunteers!
Many dots – but many gaps
We NEED more help
For information and to volunteer, visit the CoCoRaHS Web Site

http://www.cocorahs.org

Support for this project provided by NSF Informal Science Education Program, NOAA Environmental Literacy Program and many local charter sponsors.
Colorado Climate Center

Data and Power Point Presentations available for downloading

http://ccc.atmos.colostate.edu

Nolan.Doesken@Colostate.edu