The CoAgMet Network: Overview, History, How It Works, What it Shows

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Colorado Climate Center
Colorado State University

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Fort Collins, CO

With Assistance from Noah Newman
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.
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
CoAgMet =

Colorado Agricultural Meteorological Network
In the early 1990’s, CSU extension plant pathologists and USDA Ag. Research Service scientists pooled resources to start collect agricultural weather data – different but complimentary reasons.

Standard automated instruments and data collection platforms were selected and a small network of stations was deployed – mostly in irrigated ag areas.
Expansion

More applications, more partners, more opportunities -- Extension, Research, NRCS, Commodities groups, Conservation Districts and gradually water professionals

-- Northern Colorado Water Conservancy District --

For nearly 20 years we used a model of “shared benefits / shared responsibilities”
-- field techs, year-end funds, donations --
Colorado Climate Center’s role

- Coordination, data management, web support

- We hosted annual meetings of key partners and data users – set priorities, secure commitments, prepare proposals (rarely funded but we persisted)

- Key people – Harold Duke, Mark Crookston, Tom Trout, John Kleist, Howard Schwartz, Mark McMillan, Troy Bauder, Lorenz Sutherland, Harold Larson, Wendy Ryan, and plenty others.
Current and Closed stations (as of 2015)
What next, Jama??

- Expect more stations soon, primarily in the Colorado River Basin (western Colorado) as a part of Upper Colorado River Compact Commission efforts to standardize upper basin states Consumptive Use estimates.
What do the stations measure?
Cup anemometer and wind vane: Wind speed, direction and gusts

Temperature/Humidity sensor in radiation shield

Solar panel powers the station

Soil temperatures 5/-15 cm

2 m

Pyranometer: Solar radiation

Tipping bucket rain gage

1-3 m

Above all else facing South

Data collection platform (DCP)
Data Collection Platform

- Power supply
- Datalogger
- Communications device (cellular modem)
- Incoming sensor cables
Temperature/Humidity
Wind Movement
Solar Radiation
Precipitation
Soil Temperatures

Soil Temperatures for CD601 (07-31-2009 - 08-31-2009)

Generated by the Colorado Climate Center
Growing season Alfalfa reference ET for 2011 growing season comparing an unirrigated site near Delta to a partially irrigated site near Olathe
Please note:

- CoAgMet instrumentation are high quality and the CoAgMet data are easily accessible.

. . . . . However
Problems with CoAgMet

- Missing data

- Site exposure – not all sites selected with ET calculation in mind

- Routine maintenance (somewhat lacking in the earlier years of the network – much better now)
Missing/Questionable Data
(Common problem in early years, much less now)

- Battery failure and communications problems are the most common.
- Even if the whole station doesn’t fail, sensors go bad and can leave some elements missing until the station is serviced.
Some Data are Questionable
Siting and Exposure

The Good…

FTC01 Fort Collins AERC has appropriate citing for reference ET calculations

and the Not so Good

HOT01 Hotchkiss is not ideally cited for reference ET calculations
Site Exposure

► One of the assumptions of the evapotranspiration equations is that water is not limited (i.e. in full irrigation).
► Some stations are not located in ideal “reference” conditions.
► Some stations have obstructions (buildings/crops) that affect the amount of wind in certain directions.
► The exposure of the site can have an impact on the data and over/under estimate reference ET.
Instructions for using this page are available here.
Information about ET data is available here.
CoAgMet Station Map here.

Select a Date:
Use as ○ end date ○ start date.

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<td>December</td>
<td>30</td>
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Select Stations:
Hold down the control key to select more than one station.

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<th>Irrigation Status Key*</th>
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<tr>
<td>bri03 - Burlington 3</td>
<td>Partially Irrigated</td>
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<tr>
<td>cdg01 - Cedaredge</td>
<td>Dryland</td>
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<td>ctz01 - Cortez</td>
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<td>dlt01 - Delta</td>
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</tr>
<tr>
<td>dvc01 - Dove Creek</td>
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</tr>
<tr>
<td>eac01 - Eastern Adams County (landfill)</td>
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<tr>
<td>ftc03 - CSU - ARDEC</td>
<td>Unknown</td>
</tr>
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</table>

Select Crops and Planting Date:

Check ○ All ○ None

- Alfalfa (Green Up Date)
- m 04
- d 24

Done
CoAgMet Website Demonstration

It’s not beautiful but it’s fast and full of rich data
Web Data Access: http://ccc.atmos.colostate.edu/~coagmet/
(or found in the left hand menu of the Colorado Climate Center home page)

News

- Make a Donation
  Make a donation to CoAgMet. Choose "Atmospheric Science" in the pull-down menu at the top, and in the "comments" field at the bottom, indicate "Gift is for Colorado Climate Center - new gift fund"

- Web Services
  It is now possible to access a variety of data and metadata through the Climate Center's Web Services. This link will be useful to those accessing data using scripts.
  To see the program documentation or to run Web Services, go here.

- Older Posts
  Find older posts here.

- Station Index
  Metadata on all of the stations on the CoAgMet network.

- Monthly Summaries
  Interactive access to the daily data set for a particular station and selected months.

- Daily Summaries (all stations)
  Daily summary files are formatted to display selected parameters for all stations.

- Hourly Data Access
  Interactive access to the hourly data set for a particular station and selected days.

- Hourly Data Plots
  Plots of temperature, humidity and wind for all CoAgMet stations.

- Raw Data Access
  Direct access to the raw data. Select hourly or daily data from our archives.

- Web Services
  Access to a variety of data including CoAgMet. Web Services are especially useful to those who are using scripts to access data.

- Map of CoAgMet Stations
  A Google Maps based map showing CoAgMet station locations. Access current data, metadata and images.

- Miscellaneous Tools
  Miscellaneous tools and analyses.

- Other Climatic Data
  The Colorado Climate Center maintains a database of historical climatic data for many weather stations throughout Colorado.
  Email questions, comments, or concerns about the CoAgMet page to the webmaster

Disclaimer   Equal Opportunity   AASC Policy Statement
Crop Specific ET Reports

- **About CoAgMet**
  A brief history of how CoAgMet came to be.

- **CoAgMet factsheet** has useful information on using this page.

- **CoAgMet Crop Water Use (ET) Access**
  Page for obtaining crop and turf water use information (ET).

- **CoAgMet Text Message Service.**
  Sign up for our SMS/email message service. You will be able to customize the messages sent to your cell phone (or email address).

- **Evapotranspiration Reports**
  ETRs are daily reports for selected stations by region.

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  A description of a typical CoAgMet station.

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Crop Specific ET Reports

CoAgMet Extended Crop Evapotranspiration

Station: Hebron
Location: 13 miles SW of Walden
Elevation: 8170
Longitude: 106.388
Latitude: 40.5455

<table>
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<th>Date</th>
<th>Alfalfa</th>
<th>Corn</th>
<th>Drybeans</th>
<th>Smallgrn</th>
<th>Sgrbeets</th>
<th>Potatoes</th>
<th>Onion/sd</th>
<th>WntrWheat</th>
<th>Turf</th>
<th>RelET</th>
<th>Precip</th>
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<td>0.05</td>
<td>0.14</td>
<td>0.21</td>
<td>0.01</td>
</tr>
</tbody>
</table>

• Calculates multi-day ET for: alfalfa, corn, dry beans, small grain, sugar beets, potatoes, onion, winter wheat, turf grass, via ASCE standard (daily or hourly) and Kimberly-Penman modells
Daily Text Message Services

- **About CoAgMet**
  A brief history of how CoAgMet came to be.

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Daily Regional Climatic and ET Comparison

CoAgMet Regional ETR Summary Results

CoAgMet/NCWCD Meteorological Data for 5/30/2007

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<th>ARDEC</th>
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<td>57.6</td>
<td>55.6</td>
<td>50.5</td>
<td>56.0</td>
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Crop Evapotranspiration

| Alfalfa            | 0.06   | 0.06  | 0.05   | 0.05   | 0.05   | 0.06   | 0.05  | 0.06   | 0.06   | m      | 0.06 | 0.06   | 0.07   |
| Corn               | 0.04   | 0.04  | 0.03   | 0.03   | 0.03   | 0.04   | 0.03  | 0.04   | 0.03   | m      | 0.04 | 0.03   | 0.04   |
| Drybeans           | m      | m     | m      | m      | m      | m      | m    | m      | m      | m      | m    | m      |
| Smallgrn           | 0.04   | 0.04  | 0.03   | 0.03   | 0.03   | 0.04   | 0.03  | 0.04   | 0.03   | m      | 0.04 | 0.03   | 0.04   |
| Sgrbheets          | 0.04   | 0.04  | 0.03   | 0.03   | 0.03   | 0.04   | 0.03  | 0.04   | 0.03   | m      | 0.04 | 0.03   | 0.04   |
| Potatoes           | m      | m     | m      | m      | m      | m      | m    | m      | m      | m      | m    | m      |
| Onion/sd           | 0.07   | 0.07  | 0.06   | 0.06   | 0.06   | 0.07   | 0.05  | 0.07   | 0.07   | m      | 0.07 | 0.07   | 0.08   |
| WntrWheat          | 0.04   | 0.04  | 0.03   | 0.03   | 0.03   | 0.04   | 0.03  | 0.04   | 0.03   | m      | 0.04 | 0.03   | 0.04   |

North Central Region, May 30, 2007
### CoAgMet Regional ETR Summary Results

**North Central Region**

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<th></th>
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<th>Kersey</th>
<th>Kersey</th>
<th>Lucern</th>
<th>Greeley</th>
<th>Gilcrs</th>
<th>FtLptn</th>
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North Central Region, September 1, 2015
### CoAgMet Regional ETR Summary Results

Lower Arkansas River Basin 2, July 18, 2015

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Crop Evapotranspiration

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Lower Arkansas River Basin 2, July 18, 2015
Station Description

- **About CoAgMet**
  A brief history of how CoAgMet came to be.

- **CoAgMet factsheet** has useful information on using this page.

- **CoAgMet Crop Water Use (ET) Access**
  Page for obtaining crop and turf water use information (ET).

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  Sign up for our SMS/email message service. You will be able to customize the messages sent to your cell phone (or email address).

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  ETRs are daily reports for selected stations by region.

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  Metadata on all of the stations on the CoAgMet network.

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  Interactive access to the daily data set for a particular station and selected months.

- **Daily Summaries (all stations)**
  Daily summary files are formatted to display selected parameters for all stations.

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- **Hourly Data Plots**
  Plots of temperature, humidity and wind for all CoAgMet stations.

- **Raw Data Access**
  Direct access to the raw data. Select hourly or daily data from our archives.
Station Description

Most stations have a similar configuration, but sensors, dataloggers and settings vary somewhat throughout the network.

Details of the models and specs for the following:

Sensors
- Temperature and Relative Humidity
- Wind
- Solar Radiation
- Precipitation
- Soil Temperature

Data Loggers
Example Site Photos
Station Index

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## Station Index

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Click on any Station ID to see more information.
**CoAgMet Stations Details**

**ID:** HYK02  
**Name:** Holyoke  
**Location:** 12 mi SE Holyoke  
**Latitude:** 40.4909  
**Longitude:** 102.089  
**Elevation:** 3735 ft  
**Num Daily Obs:** 8,318  
**Num Hourly Obs:** 200,462  
**First Observation:** 01-02-1992  
**Last Observation:** 09-01-2015  
**Irrigation type:** dry  
**Comment:** Approaching dryland conditions Station sited in a unirrigated grassland Distant center-pivot irrigation  
**Owner:** Ron & Tommy Thompson  
**Sponsor(s):** CSU Ag Experiment Station - Fort Collins  
Haxtun Conservation District
Monthly Station Summaries

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# Monthly Station Summaries

## Station: Larand

**Location:** 8 miles south of Welden  
**Elevation:** 8252  
**Longitude:** 106.3  
**Latitude:** 40.6126

## Summary for Larand - 08/2015

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<th>in.</th>
<th>mph</th>
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Daily Climatic Summary

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  A brief history of how CoAgMet came to be.

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### Daily Climatic Summary

**CoAgMet Daily Summary - 9/1/2015**

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**All Stations**

(more than shown here)
Hourly Climate Data Plots

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Hourly Climate Data Plots

COW01 Cowdrey June 10, 2015 through June 15, 2015

Temperature

Relative Humidity
Hourly Climate Data Plots

BNV01 Buena Vista Sept 1, 2014 through Sept 1, 2015

Wind Speed

Solar Radiation
Inferior Data Do Exist

RFD02 Rocky Ford Nov 1, 2002 through Oct 31, 2003

Wind Speed

Solar Radiation
But the graphics

FRT02 Fruita Nov 1, 2001 through Oct 31, 2002

Wind Direction

Relative Humidity
Make it quite obvious
ORM01 Orchard Mesa Sept 1, 2014 through Aug 31, 2015

Wind Speed

Soil Temperatures
Map of CoAgMet Stations

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Miscellaneous Tools

• **Daily Statistics**

• **Daily Data** *(set your own parameters)*

• **Monthly Data** *(monthly reports for an entire year)*

• **Wind Summaries**
Want to know how many days with a max temp $\geq 90$ degrees from 2004-2014 in Haxtun?

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Miscellaneous Tools
Wind Summaries

Wind Roses
Select 8 or 16 point, daytime, night time or both

Ft. Lupton
Greeley
Avondale

16 point night time selected for all three examples above
Site Photos
4 Cardinal Directions + Ground photo
Site Photos – Year to Year Comparison

Holly (HLY01) – Looking towards the West

7/19/2010
Site Photos – Year to Year Comparison

Holly (HLY01) – Looking towards the West

7/21/2011
Site Photos – Year to Year Comparison

Holly (HLY01) – Looking towards the West

6/4/2012
Site Photos – Year to Year Comparison

Holly (HLY01) – Looking towards the West

8/21/2013
Site Photos – Year to Year Comparison

Holly (HLY01) – Looking towards the West

6/12/2014
The Fruit - nearly 25 years of ref ET data now available - neat stuff
We now rely on CoAgMet ref ET to guide U.S. Drought Monitor mapping
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/

Released Thursday, October 4, 2012
Author: Anthony Artusa, NOAA/NWS/NCEP/CPC
CoAgMet web access:

http://ccc.atmos.colostate.edu/~coagmet/
So . . . My question is “Do you have a rain gauge?”
1) If you are interested in the variations in precipitation, please join the Community Collaborative Rain, Hail and Snow Network

http://www.cocorahs.org

or see me today
CoCoRaHS (Community Collaborative Rain, Hail and Snow) – A simple but effective way to help scientists track our climate

http://www.cocorahs.org
We Even Measure Eto and the water balance
Mapping our water as it lands:  
-The Value of Volunteers with Gauges
Join Us!  Tell others!
We need rural observers

http://www.cocorahs.org