Putting Citizen Science To Practice

Noah Newman

CoCoRaHS (Community Collaborative Rain, Hail and Snow) Network
20+ Years of Citizen Science Precipitation Measurements

ESS Collaborative, January 29, 2021

Noah Newman noah@cocorahs.org

Colorado State University

A short history of CoCoRaHS

CoCoRaHS
Community Collaborative Rain, Hail & Snow Network

Photo: Virginia Waters

CoCoRaHS was born in response to the 1997 Fort Collins, Colorado Flood

The flood pointed out:

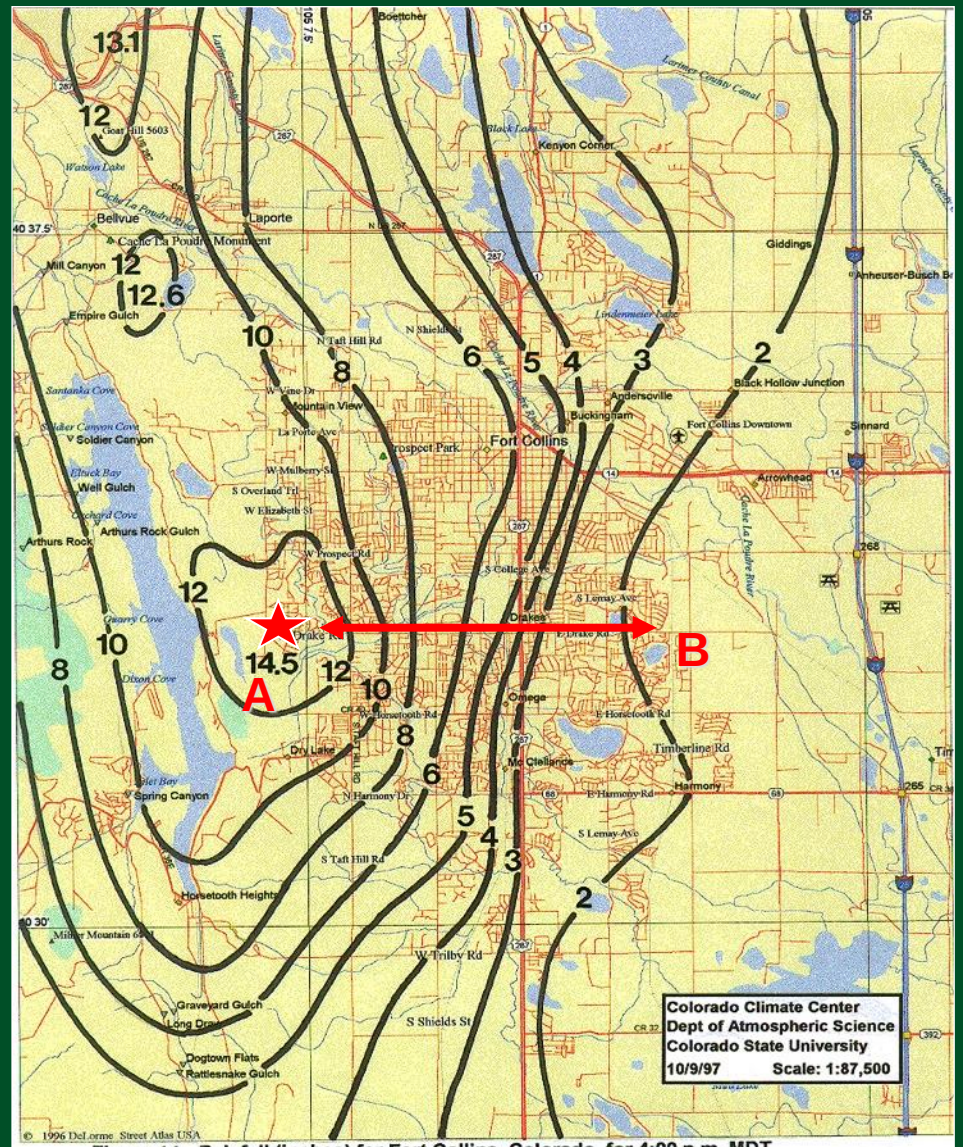


Figure 14. Rainfall (inches) for Fort Collins, Colorado, for 4:00 p.m. MDT July 27, 1997 through 11:00 p.m. MDT for July 28, 1997

1. The extreme local variations in rainfall possible from convective storms.

2. The important role individuals can play in measuring, mapping and reporting precipitation.

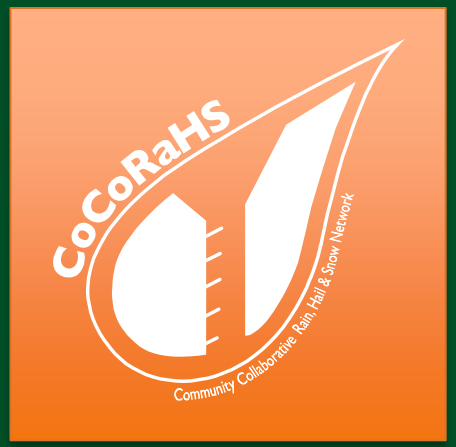
Distance between A and B = 5 miles (8 km)

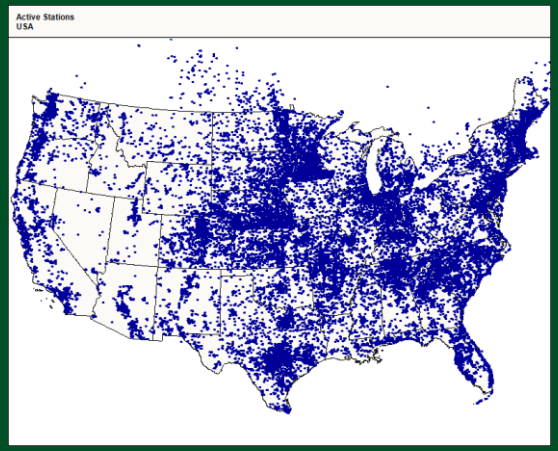
A = 14.5 inches (368 mm)
B = 2.0 inches (50.8 mm)

1998

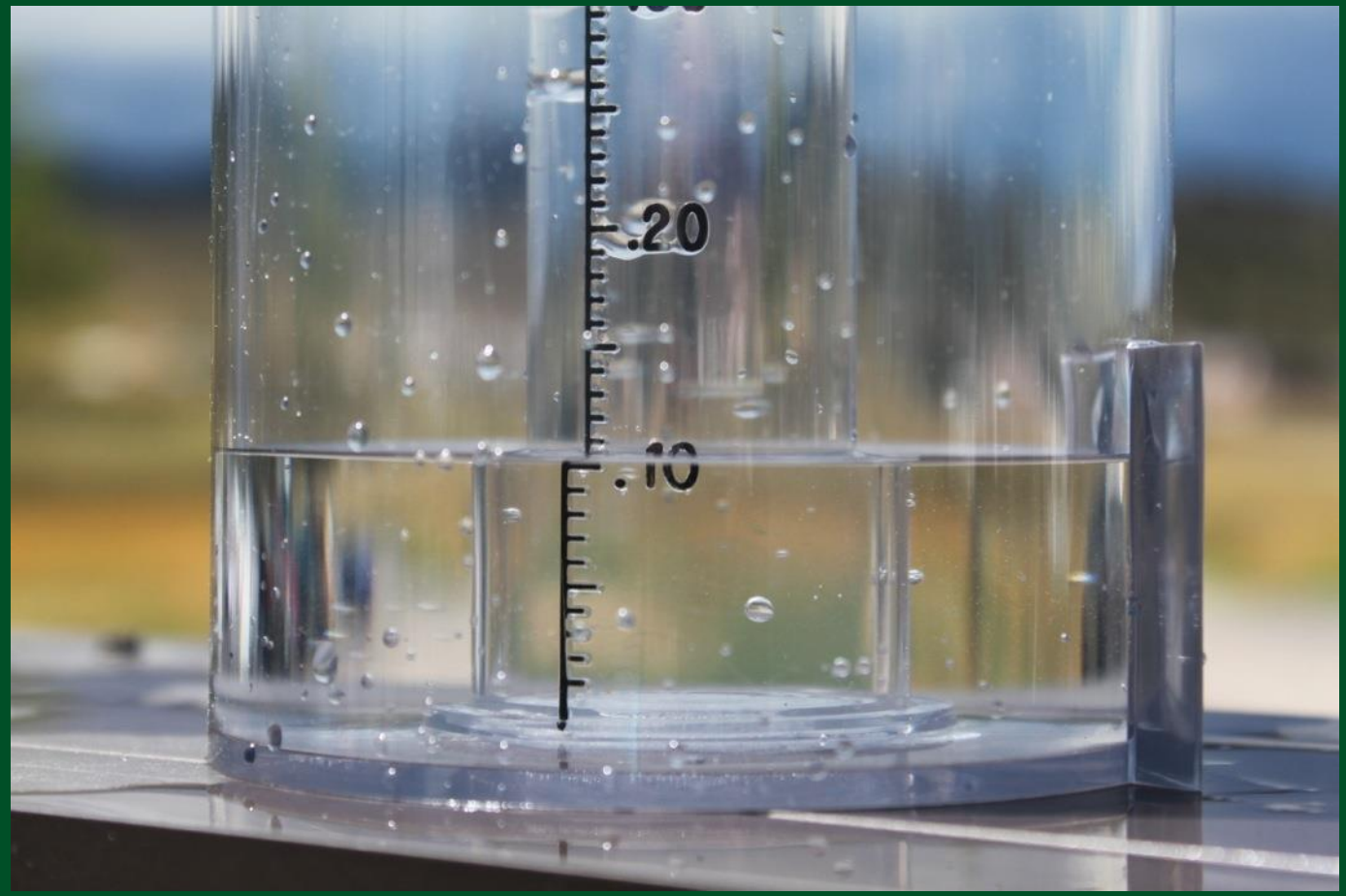
A few dozen volunteers
in Northern Colorado

Today





20,000+ volunteers in all
50 states, Canada and Puerto Rico



Two Main Goals:

High Quality Precipitation Data
and
Educational Resources and Outreach

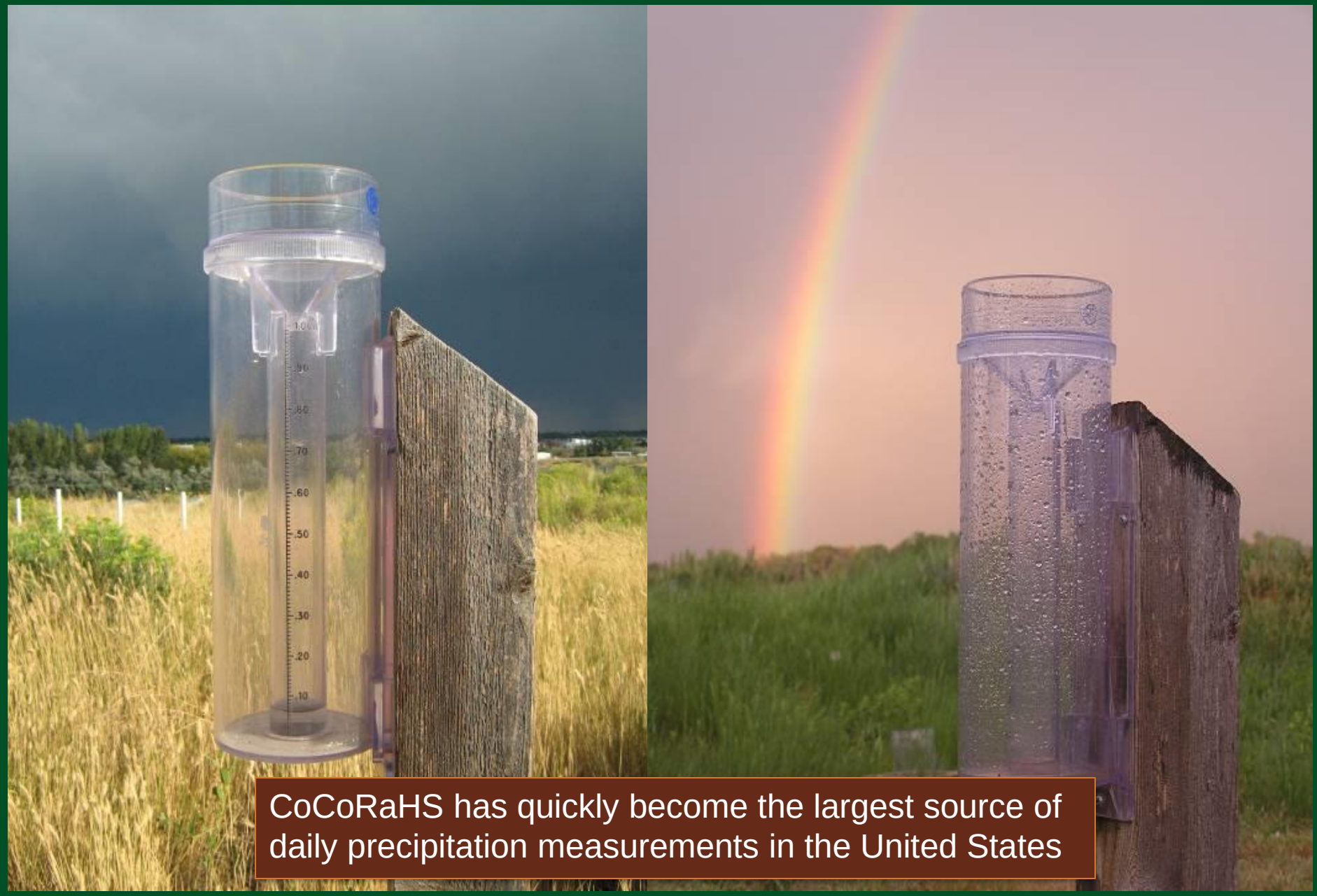
What do we measure?

RAIN

HAIL

SNOW

Rainfall Data

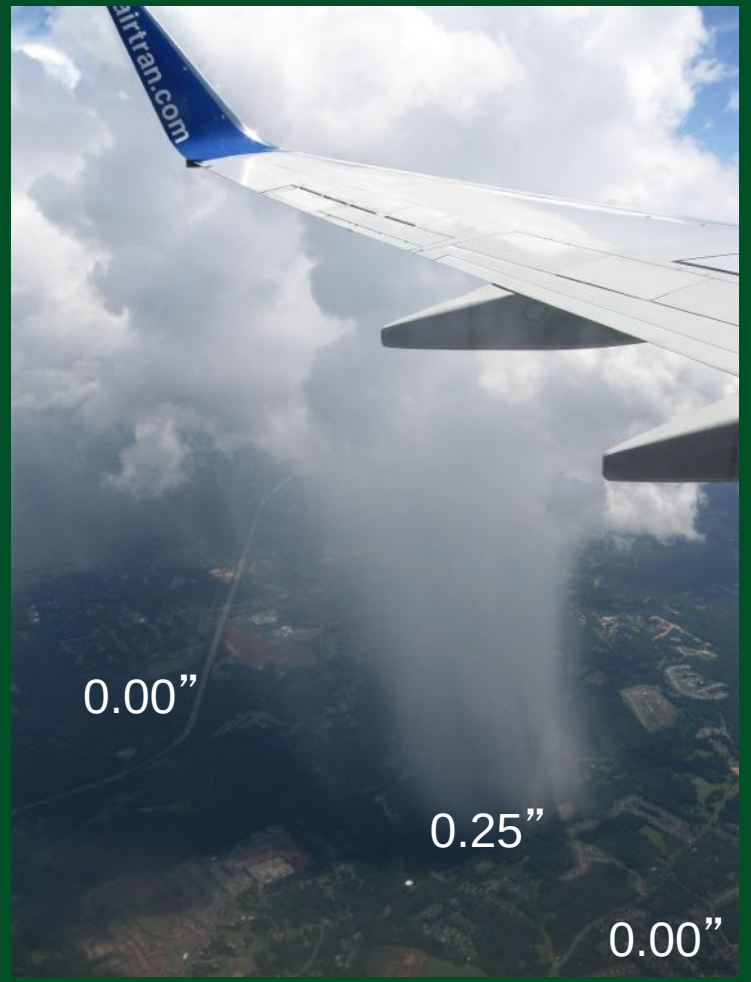


CoCoRaHS has quickly become the largest source of daily precipitation measurements in the United States

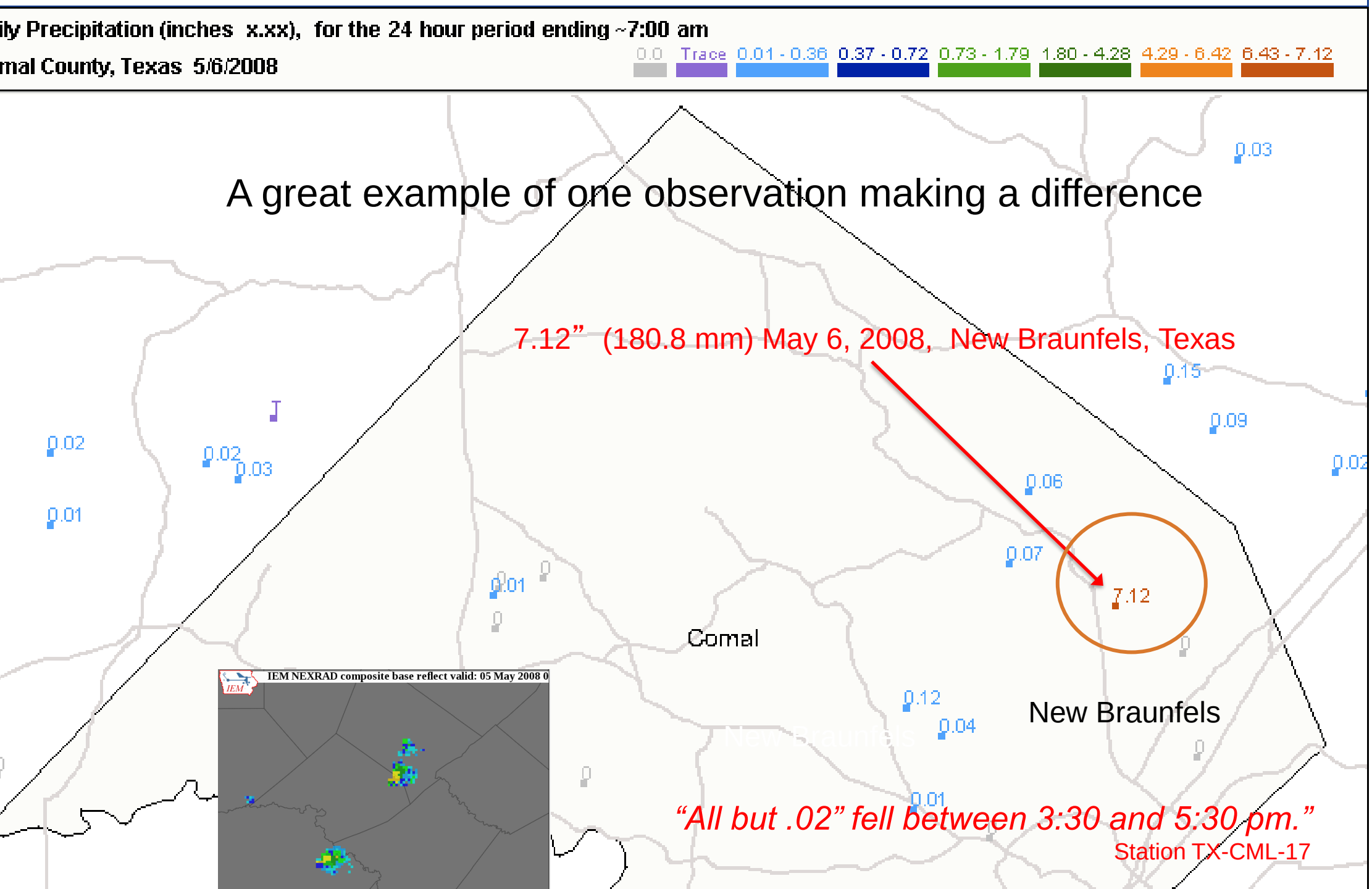
Local Precipitation Variability

Precipitation from one storm can vary from neighborhood to neighborhood, farm to farm.

“What falls at the airport may not be what falls in your yard.”



A great example of one observation making a difference



7.12” (180.8 mm) May 6, 2008, New Braunfels, Texas

“All but .02” fell between 3:30 and 5:30 pm.”

Station TX-CML-17

Hail Data

CoCoRaHS has become one of the largest repositories of hail data in the United States

Snow Data

CoCoRaHS Volunteers measure both snowfall depth (new and accumulated) as well as the water content of the snow (SWE)

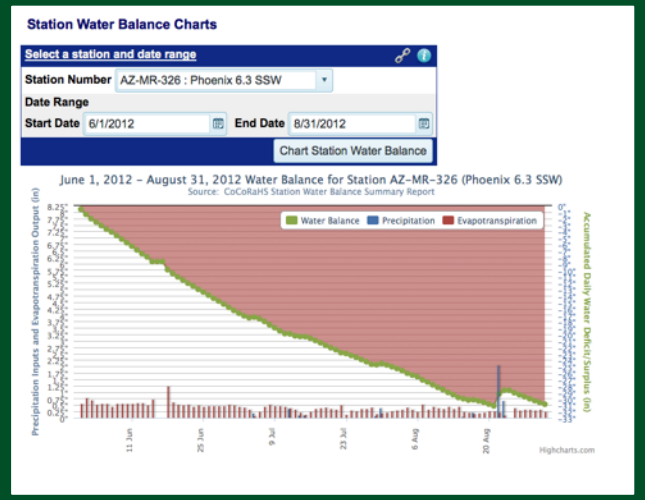
Reference Evapotranspiration

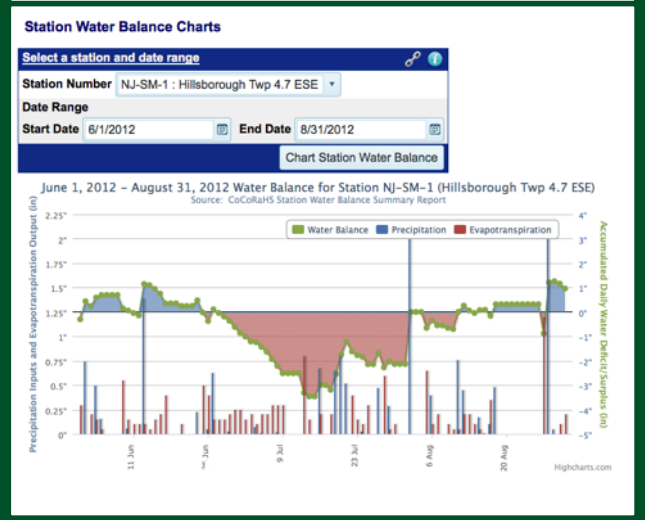
Monitoring water supply and demand

Measure what comes down with a rain gauge

Measure what goes back up with an ETgage

Water balance charts





CoCoRaHS' Formula for Good Data

A Good Gauge

The 4” (10.2 cm) diameter, high capacity plastic rain gauge

Selected a gauge that met National Weather Service
requirements so that data could be compared

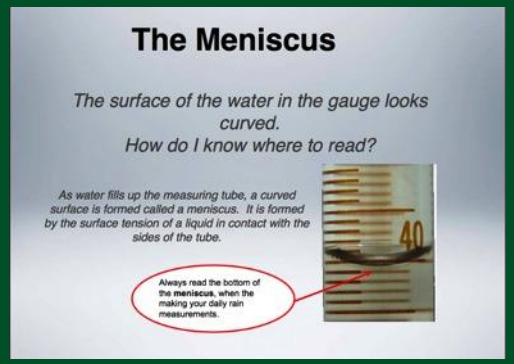
Cost around
$40 (U.S.).
Very economical

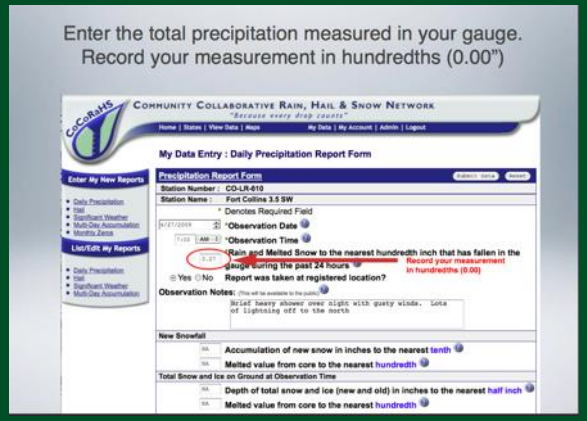
Gauge measures to the hundredth of an inch (0.2 mm). Holds 11.30” (287 mm) of precipitation.

20 year side by side measurements show 98% correlation with standard NWS 8” diameter gauge

Good Training

Each observer is trained either over the web or in person





Everyone knows what they are doing and why they are doing it.

Standard Protocols

Relative standard time of Observations

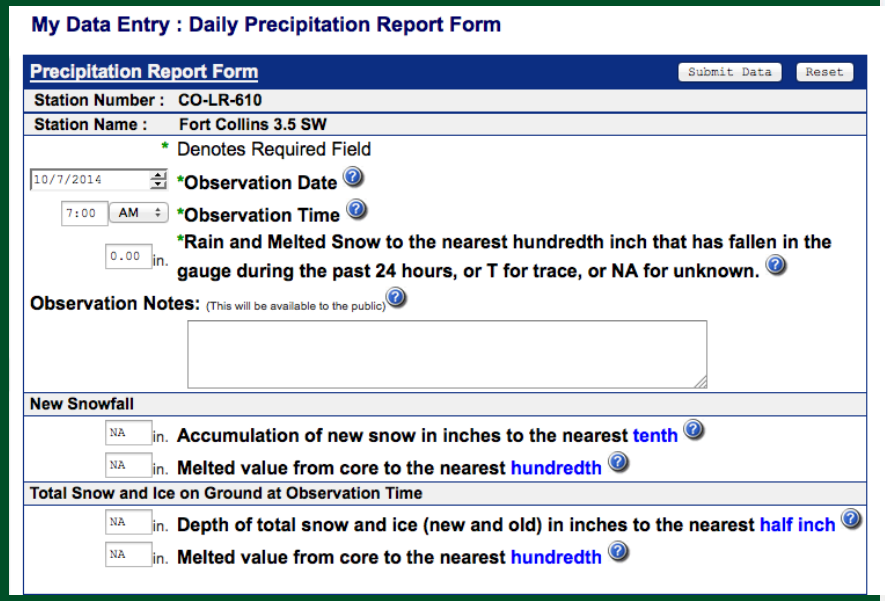
Same gauge used by all

Siting of the gauge

“Comparing apples to apples”

Good Data Management

Reporting forms


My Data Entry : Daily Precipitation Report Form

Precipitation Report Form — Submit Data — Reset

Station Number : CO-LR-610

Station Name : Fort Collins 3.5 SW

* Denotes Required Field

10/7/2014 *Observation Date

7:00 AM *Observation Time

0.00 in. *Rain and Melted Snow to the nearest hundredth inch that has fallen in the gauge during the past 24 hours, or T for trace, or NA for unknown.

Observation Notes: (This will be available to the public)

New Snowfall

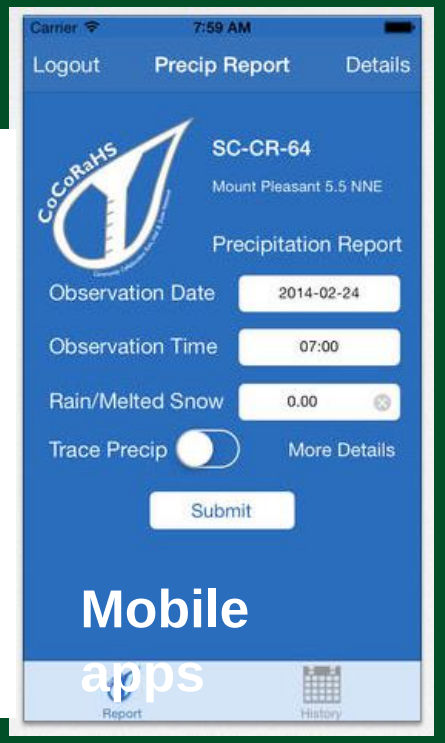
NA in. Accumulation of new snow in inches to the nearest tenth

NA in. Melted value from core to the nearest hundredth

Total Snow and Ice on Ground at Observation Time

NA in. Depth of total snow and ice (new and old) in inches to the nearest half inch

NA in. Melted value from core to the nearest hundredth



50+ million records easily available with a few clicks of a mouse!!

Rigorous Quality Control

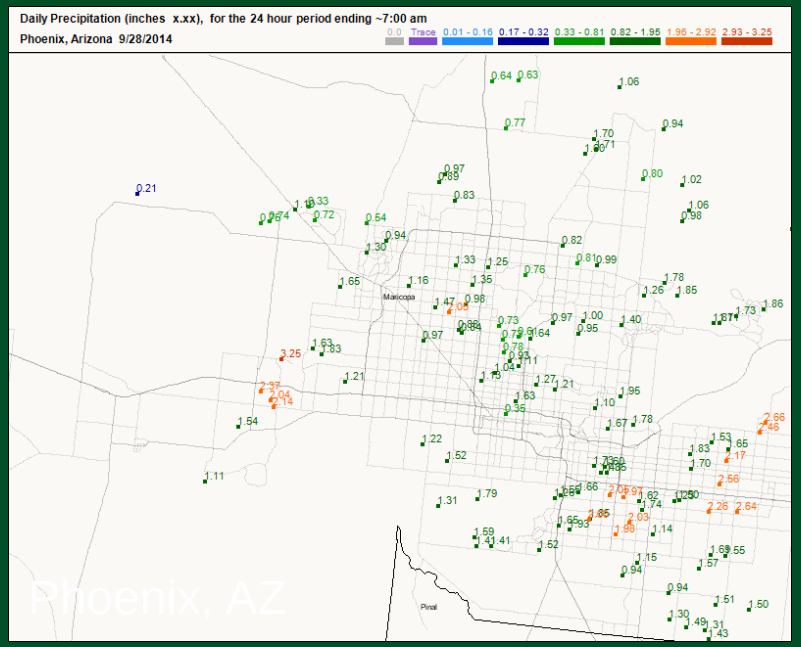
QC is built into the reporting function, as well as by the eyes of 250+ State/Regional Coordinators and CoCoRaHS Headquarters. As a result the data are of high quality.

Exportable Data

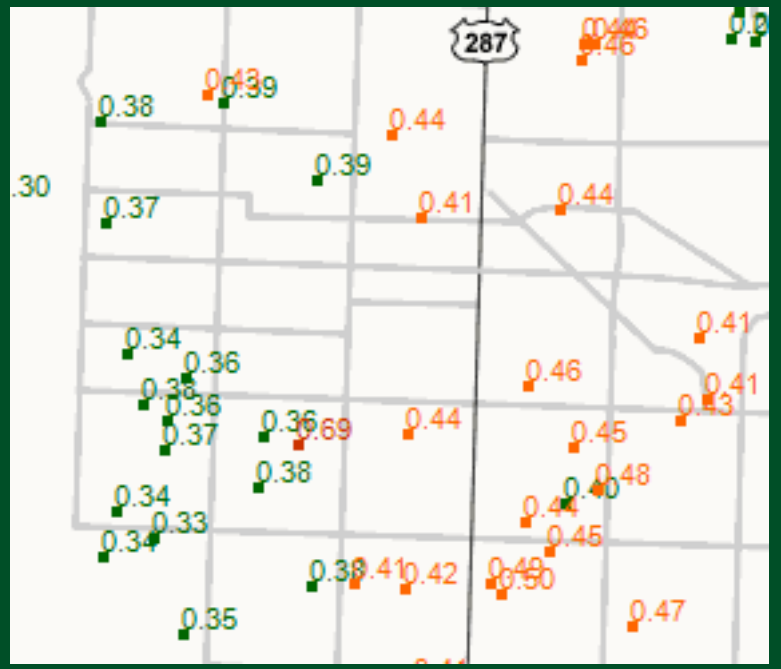
CoCoRaHS data are free and exportable to outside users. This lets the end-user customize it for making decisions.

Good Data Display

Easy to see data in spatial presentation



Observers get to immediately see how their measurement compares to those around



Ft. Collins, CO

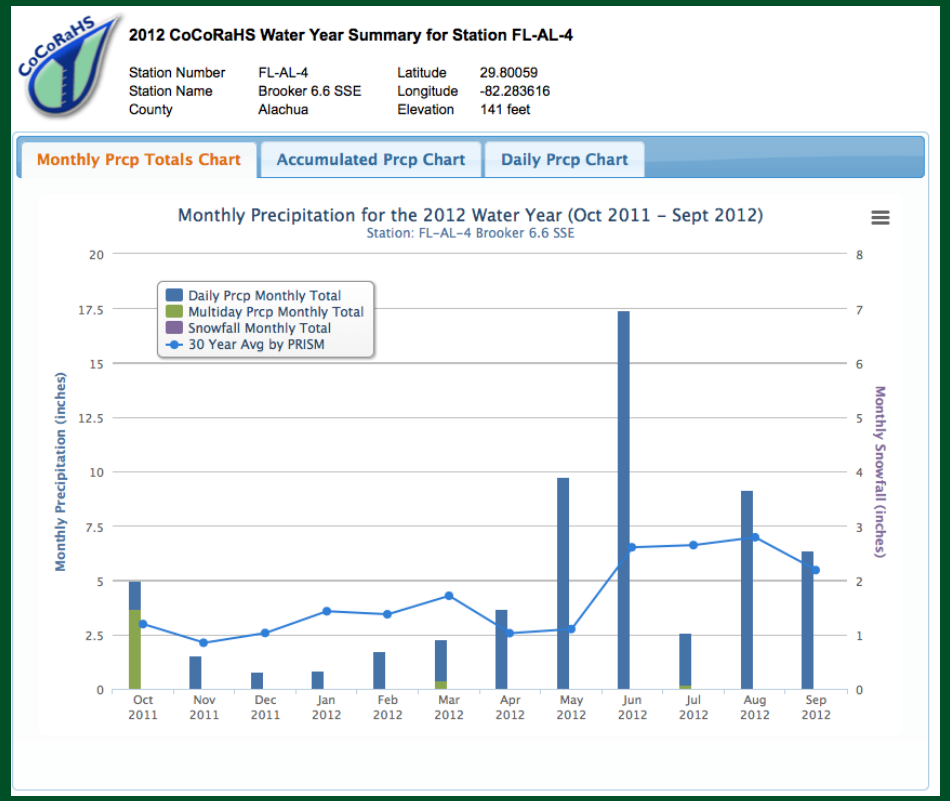
Users and observers get to track precipitation patterns together

Stations:	
CO-LR-610 Fort Collins 3.5 SW Lat: 40.5489 Lon: -105.1307	CO-LR-284 FCL 3.0 W Lat: 40.587602 Lon: -105.147301

* indicates Multi-Day Accumulation Report

Station	CO-LR-610	CO-LR-284
Date	Precip in.	Precip in.
07/20/2014	T	0.00
07/21/2014	0.05	0.29
07/22/2014	0.01	0.01
07/23/2014	0.00	0.00
07/24/2014	0.00	T
07/25/2014	0.00	T
07/26/2014	0.11	0.24
07/27/2014	0.19	0.07
07/28/2014	0.02	0.01
07/29/2014	0.00	0.00
Totals :	0.38 in.	0.62 in.

Good Data Display

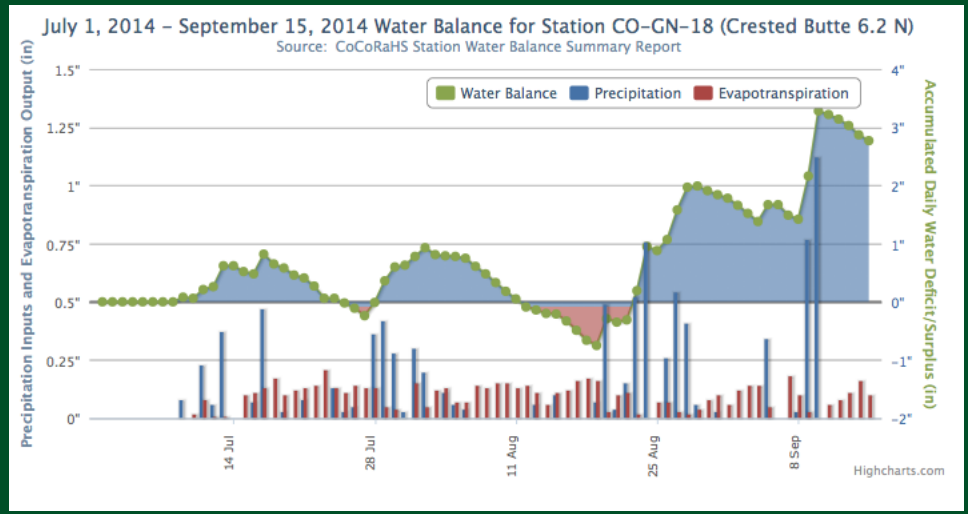


Year-End Water Summaries

Date	Time	Station Number	Station Name	Total Precip .ins	New Snow .in	Total Snow .in	State	County	View
12/9/2010	7:00 AM	CA-SN-71	Rohnert Park 0.9 SW	0.80	NA	NA	CA	Sonoma	
12/9/2010	7:00 AM	CA-SN-87	Santa Rosa 2.0 NE	0.70	NA	NA	CA	Sonoma	
12/9/2010	7:15 AM	CA-SN-84	Sonoma 1.9 NNW	0.69	NA	NA	CA	Sonoma	
12/9/2010	6:00 AM	CA-SN-61	Santa Rosa 1.3 NW	0.57	NA	NA	CA	Sonoma	
12/9/2010	7:10 AM	CA-SN-46	Sebastopol 3.0 SW	0.55	NA	NA	CA	Sonoma	
12/9/2010	8:00 AM	CA-SN-88	Occidental 2.8 SW	0.55	NA	NA	CA	Sonoma	
12/9/2010	8:00 AM	CA-SN-31	Sebastopol 2.6 SSE	0.52	NA	NA	CA	Sonoma	
12/9/2010	7:00 AM	CA-SN-28	Santa Rosa 3.1 NW	0.51	NA	NA	CA	Sonoma	
12/9/2010	7:00 AM	CA-SN-49	Sebastopol 1.1 SSE	0.49	NA	NA	CA	Sonoma	

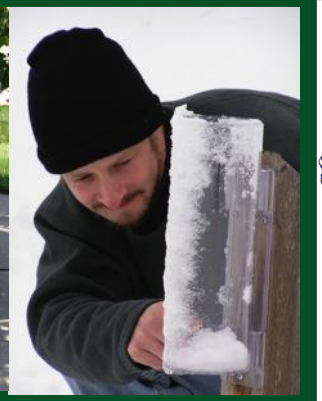
Sortable tables

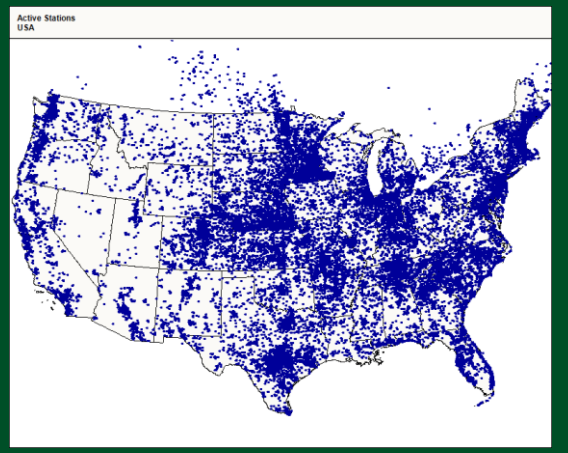
Water Balance Graphs



Many Volunteer Observers

20,000+ observers in 50 states, Canada and Puerto Rico

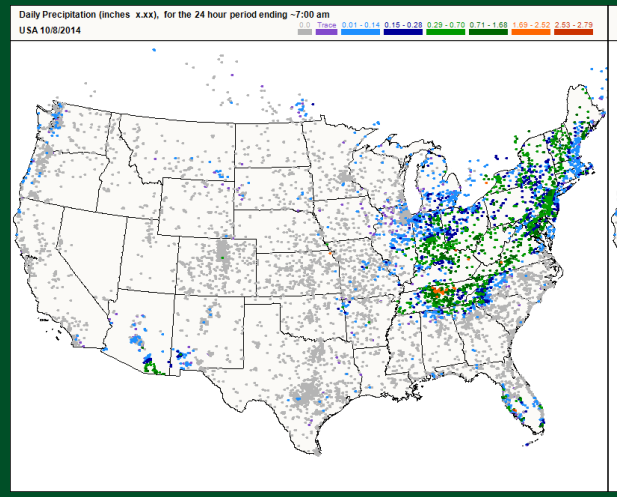




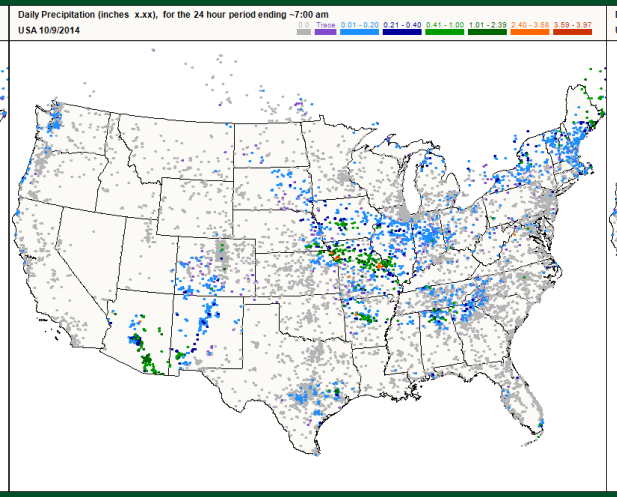
Variety of locations, both rural and urban

Many observers = many data points

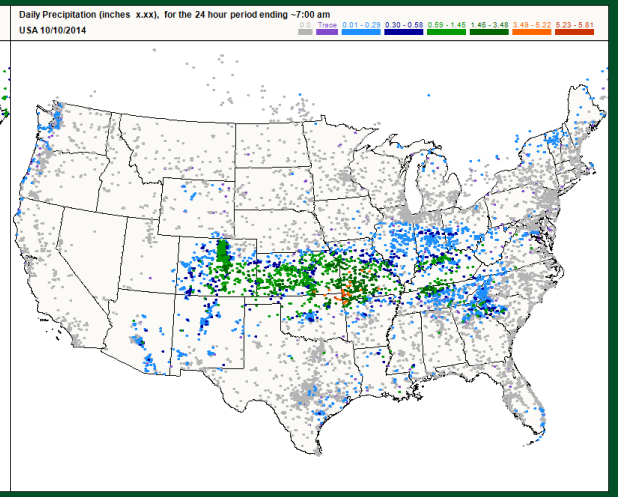
Having many observers means having a large amount of data points across a large area. CoCoRaHS is able to provide large, but easy accessed and understood data sets.



October 8th

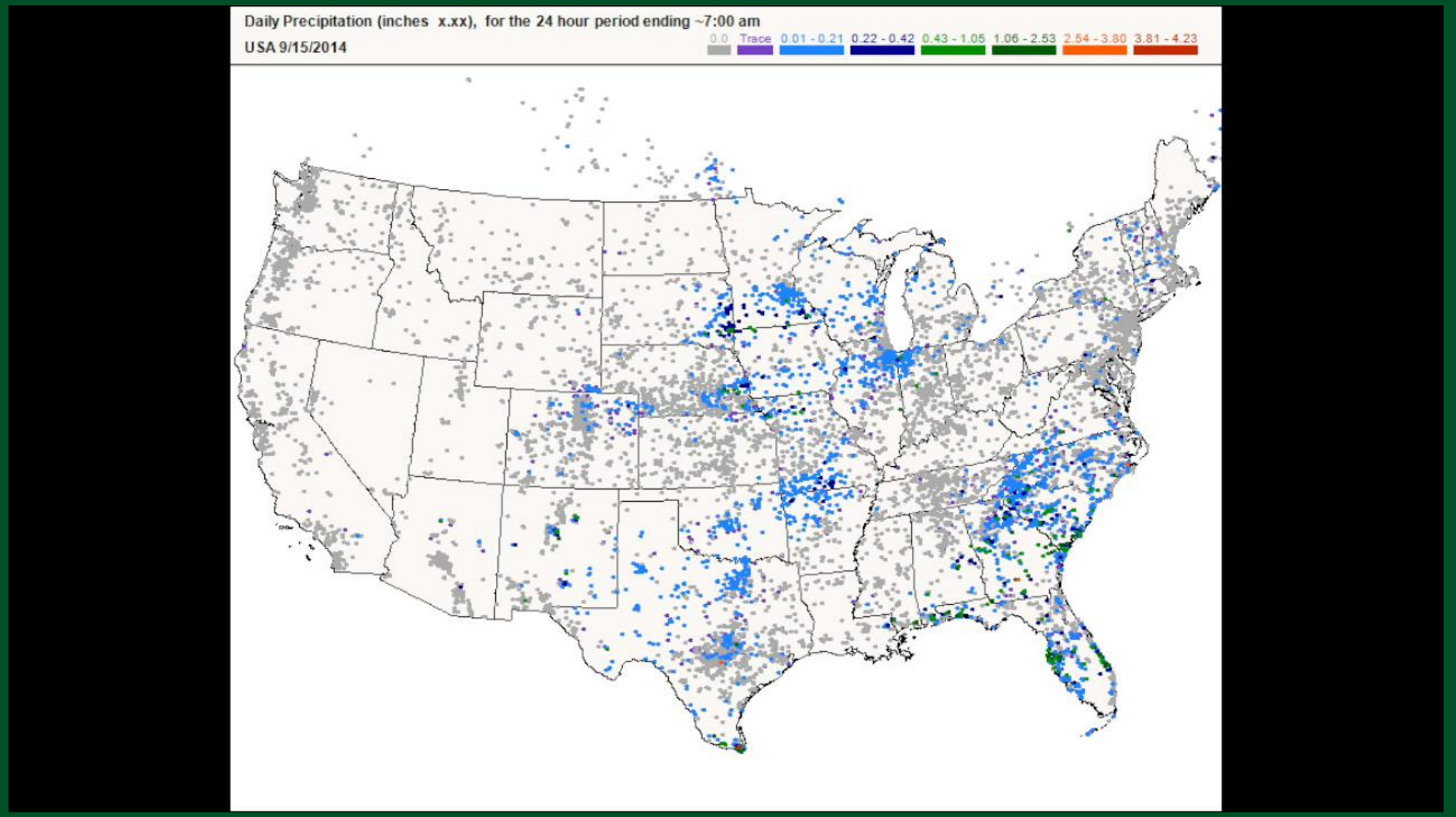


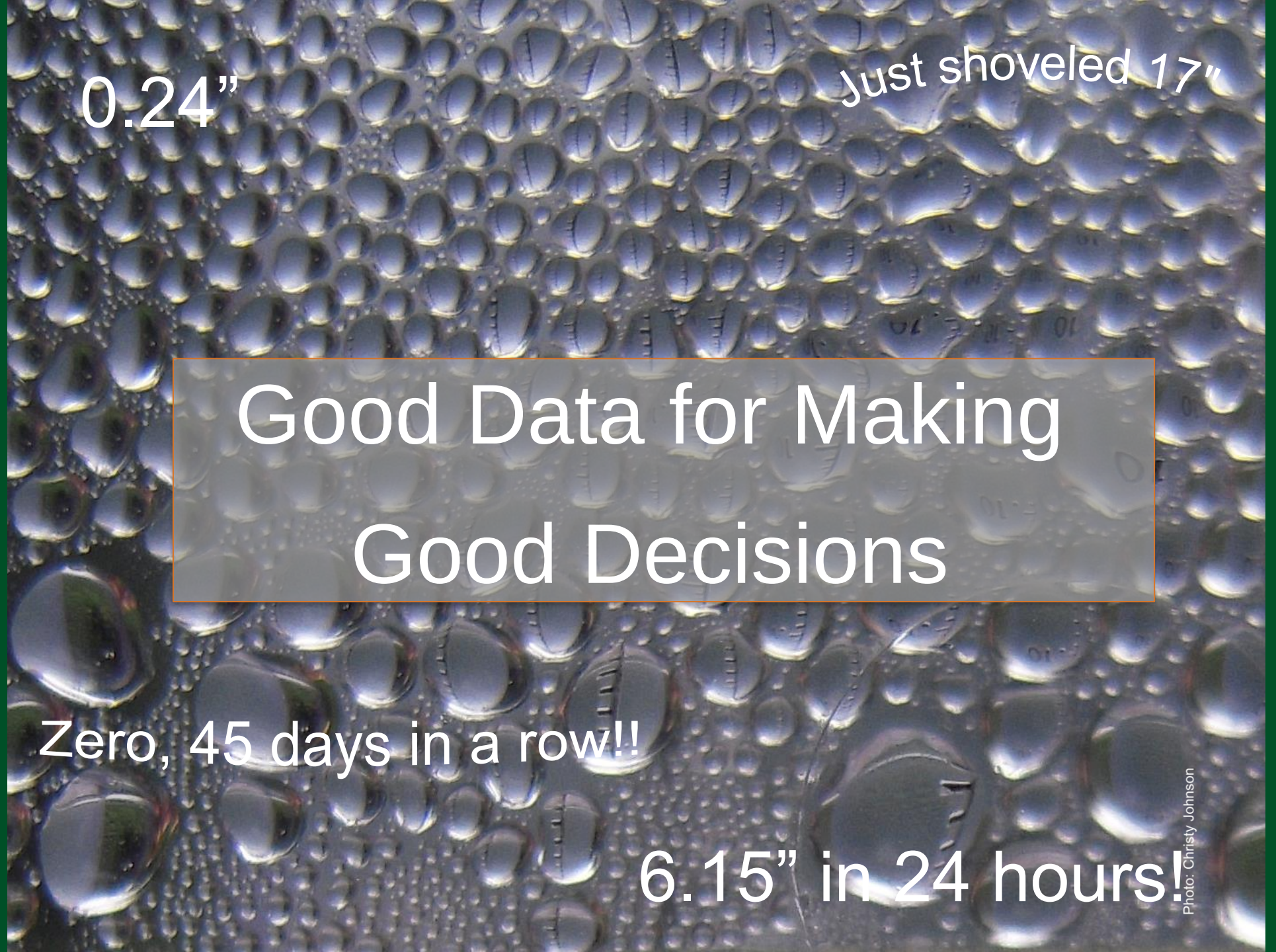
October 9th



October 10th

A month of precipitation: Sept 15 – Oct 14, 2014




0.24”
Just shoveled 17”
Good Data for Making
Good Decisions
Zero, 45 days in a row!!
6.15” in 24 hours!
Photo: Christy Johnson

Some examples of how the data are used

Drought Detection

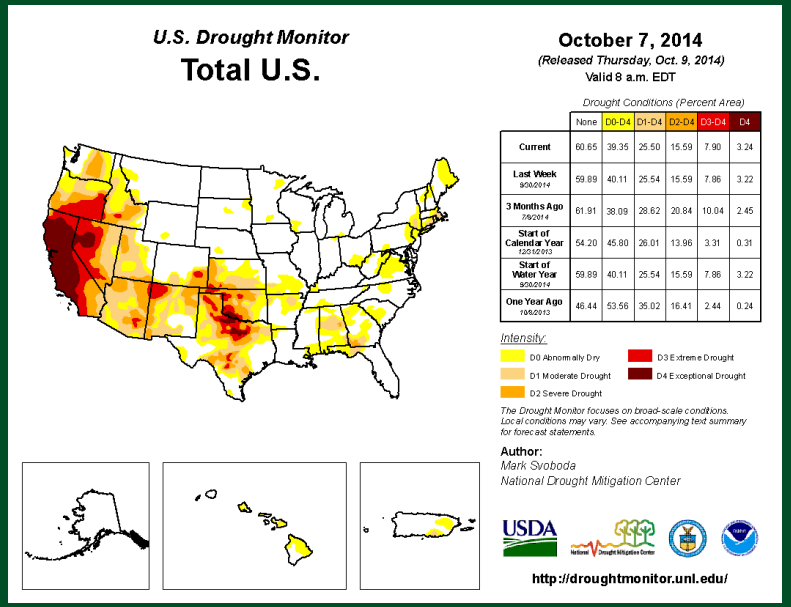
National Drought Mitigation Center

NIDIS

NATIONAL INTEGRATED DROUGHT INFORMATION SYSTEM

NIDIS UPPER COLORADO RIVER REGIONAL DROUGHT EARLY WARNING SYSTEM

Is drought knocking at your door?



CoCoRaHS data/maps used weekly to see if drought conditions have worsened or improved over an area.

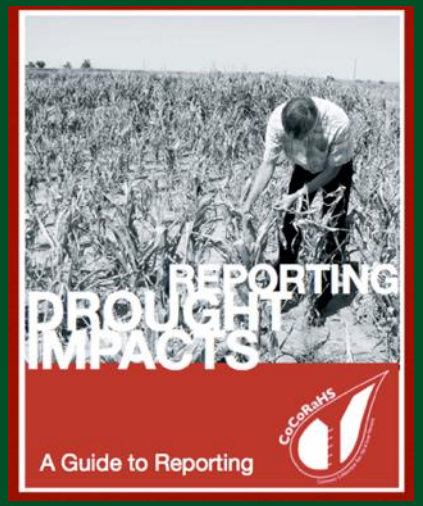
Improved Drought Awareness

"Making citizens aware of how the lack of precipitation can impact they daily lives"

Drought Impact Report

Station Number: TX-BND-5
Station Name: Bandera 3.9 E
Start Date: 12/10/2010
End Date:
Submitted: 12/10/2010 7:31 AM
Description: Have curtailed outside burning. Native plants are suffering, large and small wildlife are attracted to any available water source, smaller ponds and creeks are drying up, level of Medina river (about 1/2 mile from property) is noticeably dropping. Local roads are deep in dust.
Drought Impact Categories:
- Fire : $0.00
- Plants and Wildlife : $0.00

National Drought Mitigation Center



DRINKING WATER TASTE DUSTY?

CoCoRaHS Drought Impacts

Report how drought is impacting your community with a "Drought Impact Report"

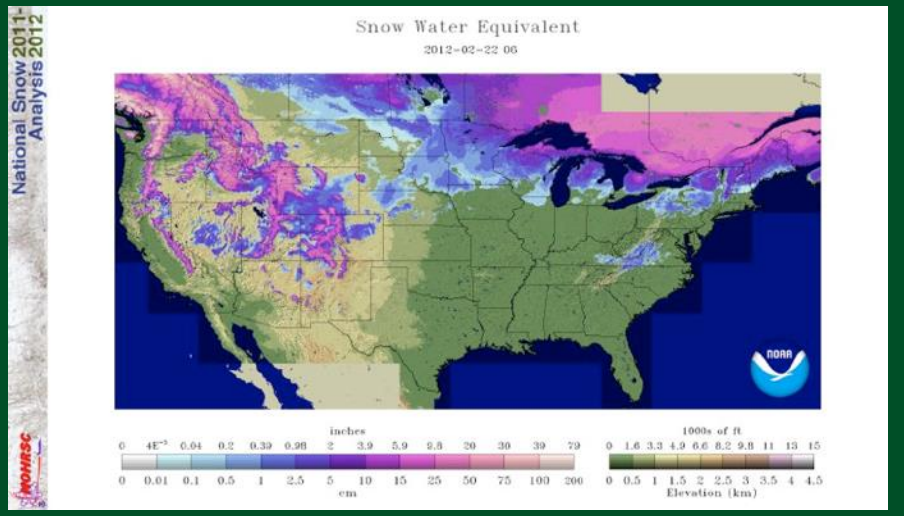
Water Supply and Water Quality

*The effects of drought have significant impacts on our **water supply and water quality**.*

Examples of drought-induced water supply and quality impacts include: Dry wells, water restrictions, changes in water rates, easing of water restrictions, increase in requests for new well permits, changes in water use in water use due to water restrictions, greater water demand, decrease

Citizens Reporting Drought Impacts

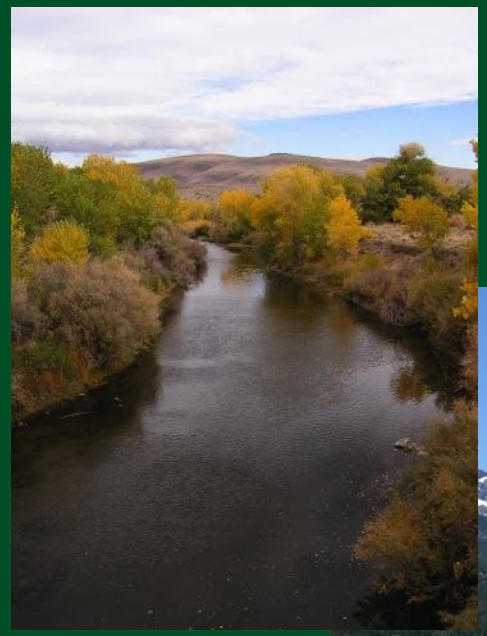
NOHRSC - (National Operational Hydrologic Remote Sensing Center)

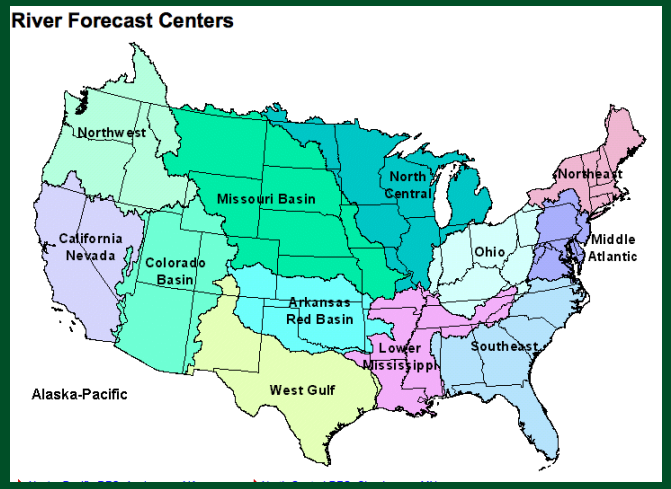


SNOW WATER EQUIVALENT (SWE) FOR SNOWPACK MONITORING

Over 50% of their snow observation reports came from CoCoRaHS observers

NOAA's River Forecast Centers





"Your data has filled in the holes in our NWS/USGS gage network.
It also is used to improve the bias used in our Multisensor Precipitation Estimates.
The more ground truth - the more accurate our river forecasts are."

Patricia Wnek – Middle Atlantic River Forecast Center

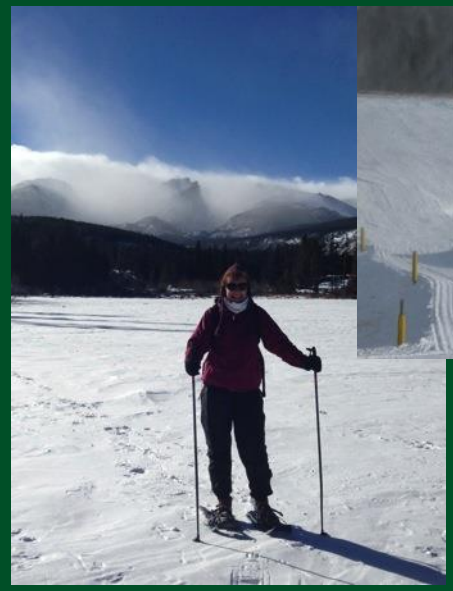
Data used by Coastal Fisheries

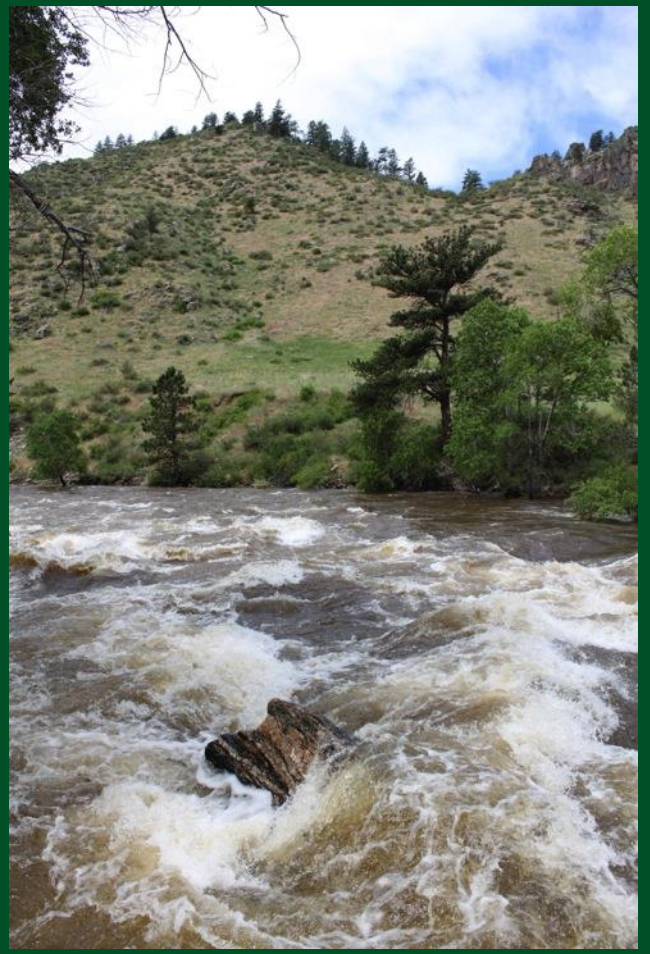
Precipitation data used to determine when to close shellfish beds

Agricultural interests

”When is the right time to plant . . . How wet is the soil?
Time to irrigate? How much rain has fallen this week?

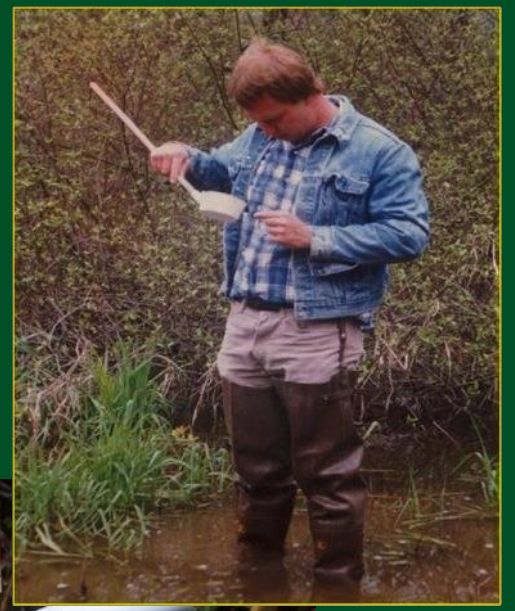
Recreational interests





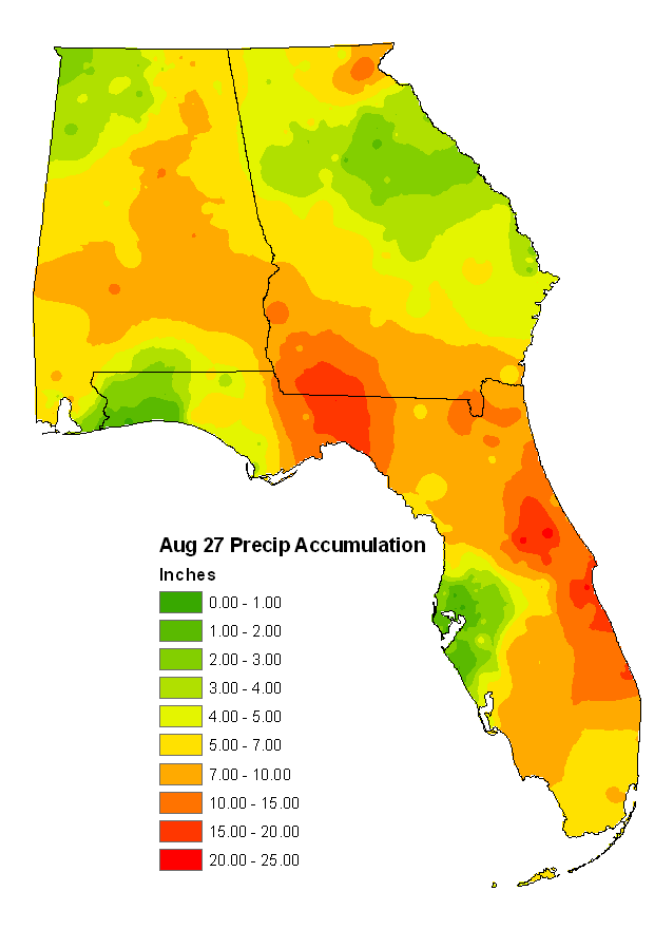
”How much snow fell at the ski slopes . . . Should we go? . . . Heavy rainfall up river last night, rafting today??”

Health related entities



”Water ponding from recent rains? . . . Time to spray for West Nile?” . . .
Mosquito control uses our data for decision making.

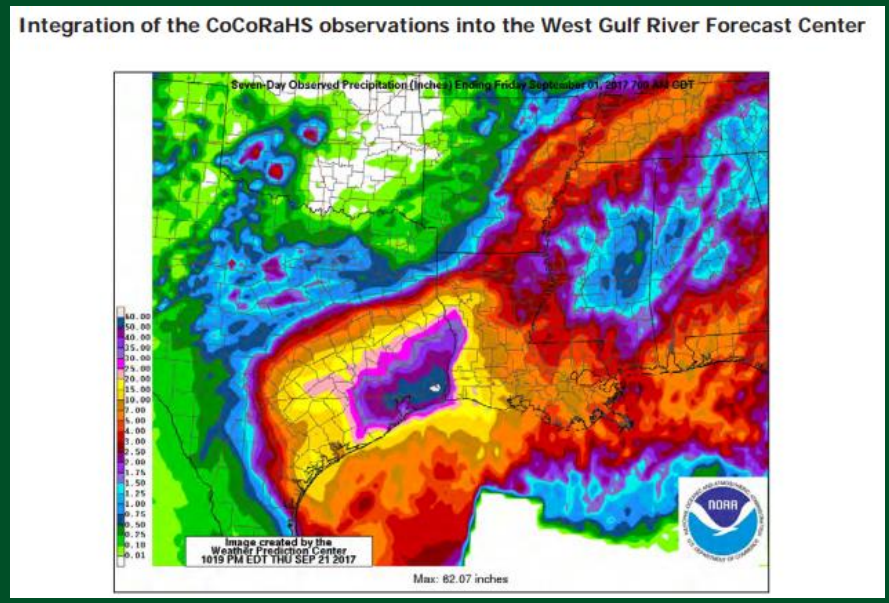
Impacts of Tropical Systems



2008 – Tropical Storm Fay

"We use the CoCoRaHS data in our post-storm summary to describe the overall impacts of a tropical cyclone event."

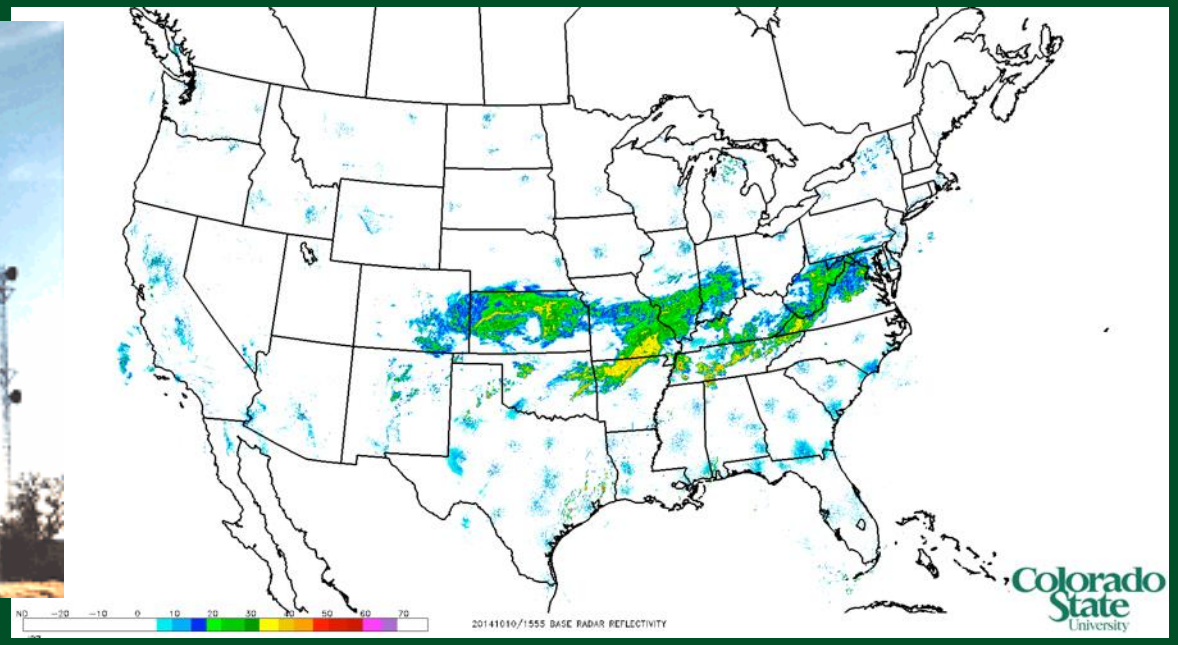
Dan Brown - National Hurricane Center



Total accumulated rainfall from Tropical System Harvey (August, 2017).

Note the 62-inch final maximum total near Beaumont/Port Arthur!

RADAR & CoCoRaHS



GROUND TRUTH RADAR

Used to “tweak the algorithm” . . . Z-R estimates based on reflectivity adjusted based on precipitation readings on the ground.

Severe Weather Decisions

CoCoRaHS instantly provides the NWS with data for Severe Weather Warning decisions

CoCoRaHS → DENCCRAHS → Possible Flash Flood, or Severe Thunderstorm Warnings issued

CoCoRaHS "Real-Time" Reports

Challenges

Encouraging Data Collection

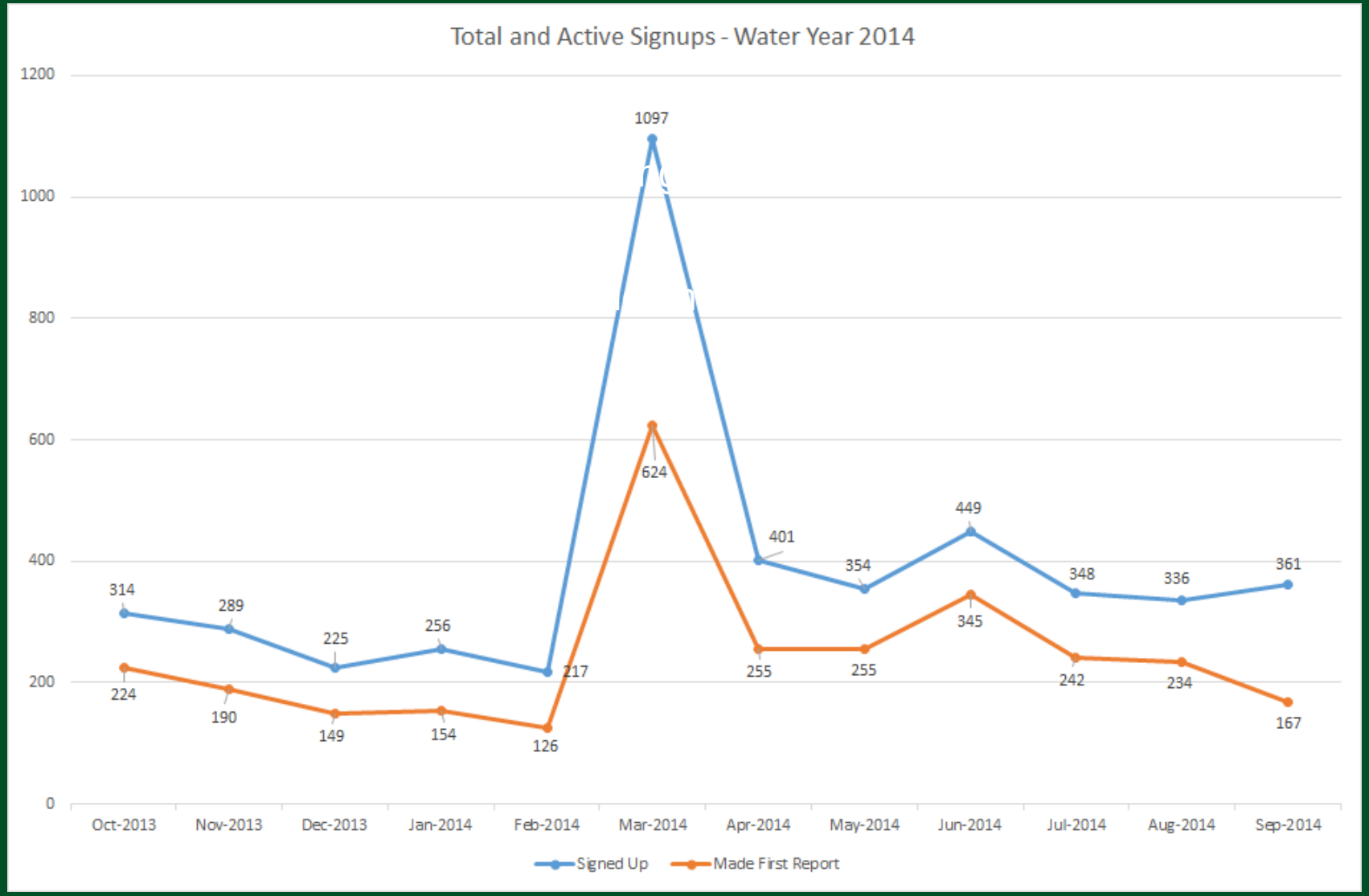
Lessons Learned

Photo: Sandy Kubicek

Recruiting Challenges

Photo: Sherman Childers

Recruiting Drive – March Madness



How do we encourage our volunteers to collect data?

- **Low cost to participate**, simple tools, not burdensome (five minutes a day), open to everyone.

- Make the process **easy and fun,** feedback on their observations (map), easy and informative website.

- **Part of something bigger** than themselves - for the common good of the nation. Observes identify with network.

  "I'm CoCoRaHS observer CO-LR-610"

- The data are **really used**, not just sitting in a book on a shelf – tell the observers who uses it. Their observation can make a difference.

- **Feedback and encouragement** from headquarters and those in the field

MANY COLLABORATIONS OVER THE YEARS

CoCoRaHS is a lowest common denominator that continues connections to scientists at universities, federal agencies and citizen-science networks all across the country.

Photo – Cheryl Albritton

CoCoRaHS has been a place for many organizations to collaborate

Climate Literacy Resources
for Schools

- **Lesson Plans and Activities**
- **Educational Animation Series**
- **State Climate Series**
- **Master Gardeners Resources**
- **WxTalk Webinars**
- **Training Videos, Slide Shows**
- **Ask an expert / Contact a Scientist**
- **Data, Data, Data!**

State and National Standards

- Science
- Math
- Geography
- More!

NGSS and Common Core

Kindergarten:

Next. Gen. Science:

K-ESS2-1

K-ESS3-2

Common Core:

Literacy: W.K.7

Math: MP.2

Third Grade:

Next. Gen. Science:

3-ESS2-1

Common Core:

Literacy: W.3.7

Math: MP.2

Middle School & High School

MS-ESS2-5

HS-lS4-5

http://scistarter.com/blog/2014/01/citizen-science-classroom-series-cocorahs/#sthash.xHJg3znt.dpbs

For more information visit:
www.cocorahs.org
or contact: noah@cocorahs.org