

## THE COMMUNITY COLLABORATIVE RAIN, HAIL AND SNOW NETWORK (COCORAHS): VOLUNTEERS MONITORING PRECIPITATION ACROSS THE NATION—THE NEXT STEP

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### 1. INTRODUCTION TO COCORAHS

CoCoRaHS, the Community Collaborative Rain, Hail and Snow Network, is a large and growing group of volunteers of all ages and diverse backgrounds who measure and report precipitation from their homes and businesses. CoCoRaHS utilizes the internet to gather and share data collected by volunteers in order to map, study and share precipitation amounts and patterns in local detail.

CoCoRaHS was initially started in Fort Collins, Colorado following a devastating flash flood in 1997 where existing sources of information (meteorological radar, satellite data, official weather stations and spotter reports) failed to accurately capture the intensity and extent of a localized storm. Over 14 inches (355 mm) of rain, the most ever measured from a convective storm over an urbanized area in the Rocky Mountain region, caused extreme urban flooding both in and outside of designated floodplain areas. Five local residents lost their lives and damage exceeded \$200 million.

The Colorado Climate Center immediately began a post-storm survey to determine the quantity, intensity and spatial pattern of precipitation from the storm. Few rain gauges from formal networks were in the path of the storm, although the official NWS Cooperative Network weather station on the campus of Colorado State University measured 5.44 inches. However, by appealing to the public via radio, newspapers, e-mail list serves and door to door surveys, over 300 rain gauge or “bucket” measurements from local residents were assembled. From these data that were assembled over a period of several weeks, a detailed map of storm rainfall was compiled (Doesken and McKee, 1998). This map was used extensively in

understanding the meteorology of the storm and in explaining the complex patterns of neighborhood flooding that ensued.

In the months following the storm, collaborative funding was assembled from the City of Fort Collins Stormwater Utility and the Colorado Office of Emergency Management. The National Weather Service, local private meteorologists, and the local school district provided local assistance. By spring of 1998 a coordinated effort was begun to recruit, equip and train local citizens to accurately measure and report precipitation. High school students assisted in creating a website for entering rainfall reports, developing tools for mapping and displaying volunteer data, and setting up group meetings and activities for informing local residents and providing thorough training for measuring and reporting precipitation. By June of 1998 the new project was underway with a dense network of volunteers (at least one per square mile) collecting data. An interactive website functioned successfully as the communications hub for the new network. Immediately, fascinating local patterns of precipitation could be observed from practically every storm (Figure 1).

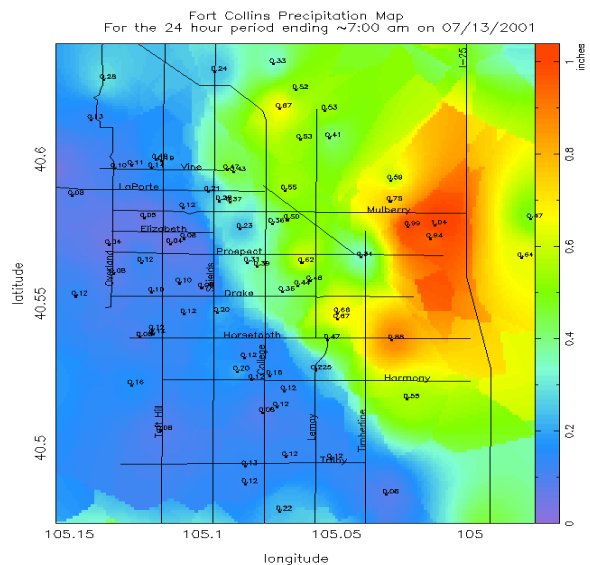


Figure 1. Rainfall pattern over Fort Collins Colorado for July 13, 2001.

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Another interesting aspect of the CoCoRaHS network were the foil-wrapped Styrofoam hail pads which proved extremely effective in objectively determining the number, the size distribution and the approximate density of hail stones from storms in this hail-prone region of the country (Figure 2).

Hail information was immediately useful for ongoing research activities by the CHILL radar facility at Colorado State University (Cifelli et al, 2005). Hail reports were also of great interest for National Weather Service forecast and warning applications. A NWS forecaster from the Boulder, CO forecast office wrote code so that any hail or intense rain report submitted by CoCoRaHS volunteers automatically appeared on the computer screen of severe weather forecasters. This feature immediately added great value to the CoCoRaHS effort as a tool for aiding severe storm tracking, documentation, forecasting and issuing local warnings.

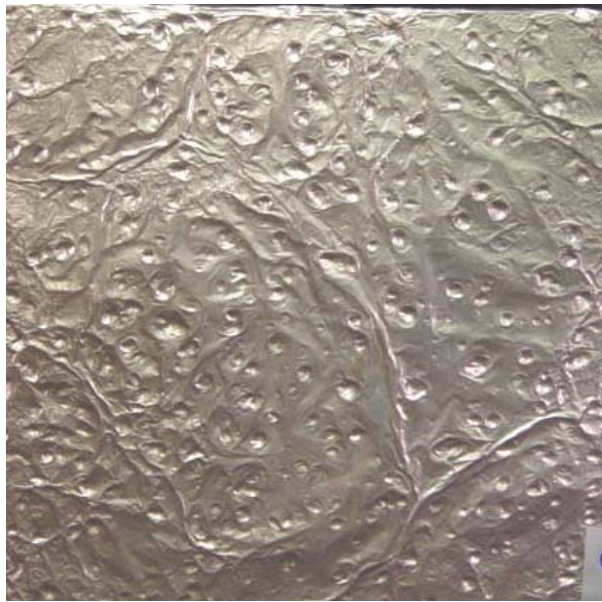


Figure 2. Hail pad for Aurora, CO, July 2, 2006 showing the dents from hail stones.

After one season of successful operation in northern Colorado in 1998, other sponsors joined the effort. The U.S. Department of Agriculture, with obvious interest in both rain and hail, began providing in-kind support to encourage expansion to rural agricultural areas of northeastern Colorado. Beginning in the winter of 1999–2000, snowfall was added as a standard CoCoRaHS measurement, and the network became a year-round activity.

## 2. RECENT ACCOMPLISHMENTS

From 2000 through 2002 the network grew to include several hundred volunteers in northeastern Colorado. Data analysis and display tools were developed to make it easy to view patterns of precipitation each day. Then late in 2002, funding was received from the National Science Foundation Informal Science Education program (NSF-ISE). This grant provided funds to expand the network to the Central Great Plains (SE Wyoming, SW Nebraska, NW Kansas and NE Colorado). This NSF funding supported a project coordinator and part-time web developer that allowed the network to flourish. Over a 3-year period a more robust website was developed, improved training resources and outreach activities were created. By the end of 2005 nearly 3000 people ranging in age from about 5 to 90 years old, had joined CoCoRaHS. The network extended to all of Wyoming, Colorado, Nebraska and Kansas. In addition, several other states volunteered to join the network—Texas, New Mexico, Pennsylvania, Maryland, Virginia, Missouri, Indiana and Oklahoma (Figure 3).

Thanks to an integrated database and web interface, all rain, hail and snow data collected by CoCoRaHS participants from the beginning of the project can be quickly accessed and displayed. Several data analysis tools allow any user to quickly access and summarize data by state or county. All CoCoRaHS data and educational resources can be access by the public at: <http://www.cocorahs.org>

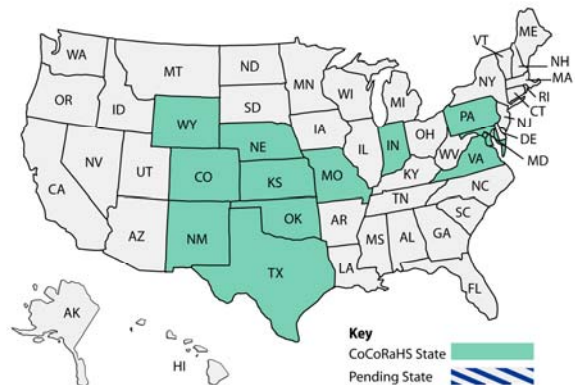


Figure 3. 2006 participating states in CoCoRaHS

## 3. EVALUATION RESULTS

Thanks to the NSF Informal Science Education grant, an independent evaluation of the CoCoRaHS network was performed with

emphasis placed on citizen participation and learning. Some key findings of this evaluation were:

- Regardless of geographic area, citizens are interested in the weather and willing to volunteer.
- While there was some interest at all levels (from elementary school age to senior citizens), senior citizens were the group most likely to volunteer and stay involved for a long duration.
- Through ongoing participation, volunteers learn basic elements of scientific data collection as well as some principles of weather, climate and hydrology. They also learn and are surprised by the many and varied way that basic precipitation data are used by science, government, research, business and education.
- e-mail communications are effective for instructing, coordinating, and motivating a large volunteer network.
- Precipitation data collected by trained volunteers are generally of high quality and suitable for both operational and research applications.
- Many organizations use and appreciate CoCoRaHS precipitation data and information. There is a very broad and supportive “user community” backing the CoCoRaHS network.
- State and local leadership are very important if not essential to maintain and expand the CoCoRaHS network.
- National Weather Service participation is very helpful and lends credibility and urgency to this volunteer program.

Evaluation results also pointed out weakness and limitations. Shortcomings of the network included:

- Low participation rates by lower income and minority populations resulted from the “self selection” method of recruiting that was used in most areas.
- Heavy reliance on the internet as the CoCoRaHS communications hub and e-mail as the primary way of providing support and feedback to volunteer participants, resulted in a lower level of involvement by participants that did not have or chose to use daily access to the internet.
- Opportunities to involve teachers and students have not been capitalized upon.

- Where there were no local leaders to spearhead the CoCoRaHS effort at a state or county level, the network languishes.

Through evaluation results, several key needs have been identified:

- Improved training materials and volunteer training opportunities including “Train the trainer” resources.
- Leadership identification and leadership development tools to help recruit, equip and train volunteers at the local level to lead the CoCoRaHS effort.
- A variety of website and database improvements including better maps, easier navigation for senior citizens, graphical data presentations, and better automated data quality assurance/quality control tools
- Effective ways to better utilize the time and energy of volunteers.

#### **4. NEW FUNDING—NEW OPPORTUNITIES**

That NSF ISE grant that supported CoCoRaHS in becoming a multi-state “Citizen Science” informal education project has expired. Fortunately, new funding was recently received from the NOAA Office of Education’s Environmental Literacy Program which will support expanding CoCoRaHS to more states, and utilize CoCoRaHS as a mechanism for community outreach and education. At the same time, CoCoRaHS participants will become an ever-larger part of the National Weather Service’s critical storm spotter and cooperative observer networks with their long and valued history of providing local and timely weather information for improving weather forecasts, severe weather warnings, climate monitoring and drought assessments.

During the next three years CoCoRaHS will be striving to accomplish the following goals

- Add five to eight new states each year to the CoCoRaHS network, ending up with at least 30 active states by 2009 and a total of 20,000 to 30,000 participants.
- Foster the development of state leadership teams to support the CoCoRaHS effort with emphasis on involving retired scientists and natural resource specialists.
- Develop “media teams” in each CoCoRaHS state to become partners with CoCoRaHS

leaders in sharing the results and entraining new volunteers and sponsors in this weather and climate study.

- Establish a long-lived spatially dense precipitation network in many parts of the U.S. providing research and service-quality data at very reasonable costs.
- Assist volunteers in become confident “citizen scientists” collecting useful data and assisting in analyzing and applying scientific data and information to help their communities.
- Increase the availability of timely reports of intense rain, hail and snow to assist the National Weather Service and other public and private entities to improve public safety, hazard awareness and environmental understanding.

Many formal and informal educational opportunities will develop along this path. CoCoRaHS will strive to encourage curiosity and learning about weather and climate while exposing participants and the general public to the many existing earth science educational resources and opportunities. Using the relevance and context of daily weather changes, we will introduce CoCoRaHS participants and visitors to the remarkable public and private research and operational weather enterprise. Through e-mail newsletters and Web-updates, we will provide opportunities to discover websites, to learn about education programs, research, internship and career opportunities and the many ways we can now view the world's oceans, atmosphere, landforms and rivers in action.

#### **4. CONCLUSION**

The backyard measurement of precipitation is the lowest common denominator for earth science exploration and learning and a small “foot in the door” that can be opened to much greater science discovery. In the years ahead, CoCoRaHS will strive to draw together thousands of people, many whom would never have realized that they would have such an opportunity presented to them to help advance science, through their participation in the network. With excitement we look forward and embrace the potential impacts that this endeavor presents.

#### **5. ACKNOWLEDGEMENTS**

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