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THE COMMUNITY COLLABORATIVE RAIN, HAIL AND SNOW NETWORK (COCORAHS)— "HANDS-ON" SCIENCE FOR COMMUNITIES RIGHT IN THEIR OWN BACKYARDS

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1. HISTORY: PAST, PRESENT AND FUTURE

CoCoRaHS, the Community Collaborative Rain, Hail and Snow Network, is an example of a "Citizen Science" project where volunteers help collect data important to scientists and not readily available from other sources. Volunteers of any age and background, but with a common interest in watching the weather, take daily measurements of rain, hail, and snow using low-cost measurement tools; 4-inch diameter high capacity plastic rain gauges and aluminum foil-wrapped Styrofoam hail pads (Figure 1). With the help of basic instruction and with frequent interaction with participating scientists, volunteers are able to collect and share data of considerable scientific value. There are very few sources of reliable snowfall observations in the U.S. and very little quantitative data on hail stone properties, so CoCoRaHS is quickly becoming a popular source of data to support remote sensing, weather forecasting and other atmospheric and hydrologic research (Cifelli, et al, 2005).

Figure 1. CoCoRaHS volunteer Dan Hirsch reading his rain gauge at Rocky Mountain National Park.

The Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) came into existence in 1998 as the Colorado Collaborative Rain and Hail Study. A flash flood that took several lives in Fort Collins, Colorado in July of 1997 pointed out the extreme local variations in rainfall possible from convective storms and the important role individuals can play in measuring, mapping and reporting precipitation. At first the project was very small with only a few dozen volunteers in Northern Colorado reporting precipitation on a website created by local high school students. Each year since then the project has grown as more people and organizations get involved. In 2003, thanks to a National Science Foundation Informal Science Education grant, the network took its largest step and expanded into the Central Great Plains. Today the network is growing rapidly with over 2,000 active participants in nine states (Colorado, Nebraska, Kansas, Wyoming, New Mexico, Texas, Pennsylvania, Maryland, Virginia and the District of Columbia) each administered by state leaders and regional or local county coordinators (Figure 2). Volunteer participation is now increasing spontaneously, mostly by word of mouth, with new applications arriving every day.

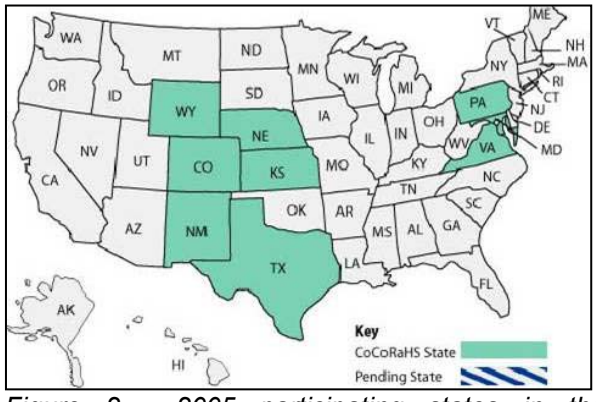

Figure 2. 2005 participating states in the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS).

Volunteers can report by phone, but most enter data on-line using an interactive web site: http://www.cocorahs.org.

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Current observations as well as past data are immediately available in map and table form for participants, project scientists and the public to view.

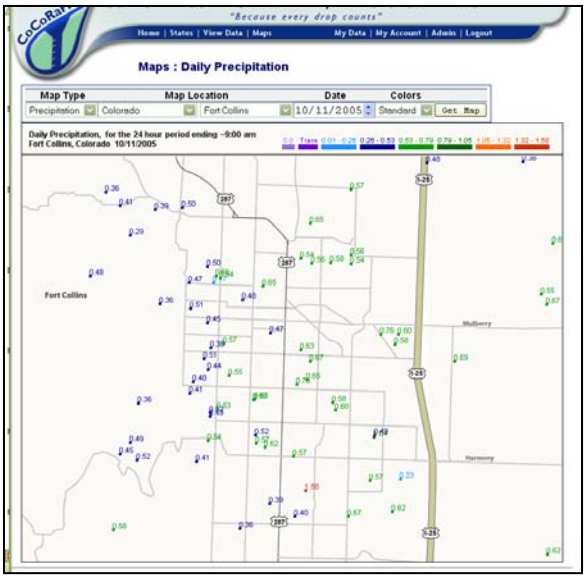

Figure 3. A typical CoCoRaHS city map as viewed via the Web.

By providing high quality, accurate measurements on the internet, the observers are able to supplement existing official weather networks with very detailed local data from their neighborhoods. Data collected in Colorado since 1998 show that to be able to accurately map rainfall patterns from summer convective storms, a density of at least one station per 3-4 square kilometers is idea. Over sparsely populated rural areas at least one station per 100 square kilometers is desirable.

2. LEARNING THROUGH PARTICIPATION

Project co-sponsors such as the National Weather Service, the U.S. Department of Agriculture, the Bureau of Land Management, and the Cooperative Extension programs or our Land Grant University System have all quickly come to appreciate the value of high-definition precipitation data collected by volunteers. The data being collected by volunteers is clearly very beneficial. But CoCoRaHS, by design, is a two-way project. We are not just gathering data collected by volunteer observers to help scientists and resource managers. We are engaging volunteers in active learning. To be an informal science education program of merit, volunteers in large numbers should be benefiting and learning substantially from their participation. In the past year, we have documented the educational opportunities offered by CoCoRaHS and begun an evaluation of outcomes. This paper summarizes preliminary findings.

3. LEARNING OPPORTUNITIES

A series of educational opportunities await each new CoCoRaHS participant. Some training is required, but most educational opportunities are optional.

Training to collect data

All volunteers, in order to collect and share precipitation data on the CoCoRaHS website, are required to learn the basics of data collection including how to set up a backyard rain gauge and hail pad, the critical importance of instrument location and exposure, common errors and how to avoid them, units of observation, and how to deal with the difficulties of measuring hail and the challenges of melting, settling and drifting snow.

Volunteers are strongly encouraged to attend group training sessions lead by CoCoRaHS staff or trained trainers. It is also acceptable to read the on-line training materials or view the on-line or CD digital annotated slide show. We are working to implement a simple certification process that will assure that all volunteers entering data on the website have learned the basic elements of observation.

Figure 4. Volunteers attending a CoCoRaHS training session in Cortez, CO.

Data collection – learning by doing

It's one thing to study how to measure rain, hail and snow but another thing to actually do it. The

bulk of learning takes place measuring and reporting. Each week we receive several thousand volunteer reports representing hundreds of hours of weather experience. This is where much of the education takes place. Most observations are accurate, but some are not. We have on-line error checking to help catch and correct certain data entry errors as they are entered. Several volunteers also manually check over all data reports each day and personally contact volunteers who may have made data entry errors. This allows constructive feedback so that CoCoRaHS volunteers can learn from their errors or convince us that their observations were accurate.

Daily maps and regional precipitation patterns – learning by seeing

All participants are encouraged to look at the CoCoRaHS rain, hail and snow maps each day and see how their local observations helped produce a more complete picture of storm tracks and water resources. Gaining familiarity with maps, and learning about spatial patterns and variations in precipitation are an important part of the CoCoRaHS experience.

CoCoRaHS Website

The website is the hub for CoCoRaHS communications and includes educational materials, data and summaries, maps and reports, station inventories, links and schedules and all the infrastructure and reference materials needed to maintain a viable citizen science project.

Message of the Day

The CoCoRaHS webmaster posts daily messages that flash to each observer after they submit their daily precipitation report or their hail or intense rain reports. These messages include brief answers to frequently asked questions, schedule information on upcoming events, and other important brief content.

E-mail updates

All participants with e-mail addresses and who are interested in our activities receive bi-weekly project updates and weather reports. This listserve was initially set up as a simple means of project communication, but it quickly became the primary method for continuing education. These updates are used to review and reinforce proper observation techniques, to communicate seasonal reminders and to answer frequently asked questions. E-mail updates are used to summarize recent interesting weather events and share information about weather forecasting, agricultural production, water supplies and other weather impacts and CoCoRaHS applications. These e-mail updates are the heart and soul of CoCoRaHS informal education and help maintain the project's sense of "community".


THE GAUGE
The CoCoRaHS Network Newsletter
www.cocorahs.org
A New Look, A New Web site!
"Because Every Drop Counts!"

Figure 5. "The Gauge" CoCoRaHS's printed newsletter.

Newsletter

At least once a year, a multi-page, multi-color printed newsletter is sent out to all participants and project sponsors. It is also posted to the web site. This newsletter reaches the several hundred volunteers who do not typically see the website or receive e-mail messages. It also provides a different media for sharing training information, calendar of events, and project findings and can serve as a more lasting reference.

Research projects – opportunities for in-depth learning and helping scientists do their work

We have found that some volunteers are eager to do more than just measure precipitation. Periodically, there are research opportunities where volunteers with more time or interest can help with special studies or data analysis. For example, during 2005 a group of individuals helped conduct special investigations of rain gauge citing and installation and identified factors that could bias readings. Also, a team of volunteers began working to review data for the past 3 years to spot data errors that persist in the data base.

Workshops and lesson plans for teachers

Over the course of the past 3 years, we have conducted several half-day workshops for teachers. We also conducted a 6-day (spread out over two semesters) credited workshop series for teachers and selected gifted and talented students in small rural school districts. This was a chance to go in much more detail into atmospheric and hydrologic processes. Working with interested teachers, a set of lesson plans related to CoCoRaHS were developed and posted to the website.

Summer Intern Program for teachers

Thanks to an annual donation from one of our sponsors, we have been able to offer a 1-2 week paid summer internship for middle school science teachers allowing a teacher to work with CoCoRaHS staff in developing training and outreach materials for students and adults and for conducting small research projects suitable for classroom use.

General workshops and field trips

Throughout the history of CoCoRaHS, we have tried to find time each year to host field trips to significant meteorological facilities such as National Weather Service forecast offices, weather radar facilities, weather observing stations, and TV weather broadcast studies. The highlight of each year has been the Rocky Mountain Weather and Climate Workshop cosponsored by CoCoRaHS, the National Center for Atmospheric Research and the National Oceanic and Atmospheric Administration. These workshops are on a first-come basis for the first 100 volunteers to sign up and have featured extraordinary presentations by nationally known scientists and weather specialists

Hail Pad Making Parties

We have recently begun to routinely involve large numbers of volunteers in manufacturing hail pads. Once each month we gather during the lunch hour in Fort Collins and enjoy food and social times while folding, wrapping and stacking hundreds of new hail pads for the coming year.

Figure 6. Volunteers at a Hail Pad Making Party

Social events

With the help of local sponsor support, volunteer recognition picnics are held annually in some participating states and counties. These are great opportunities to review the goals and accomplishments of CoCoRaHS, highlight the contribution our volunteers have made to make this a successful research and education program, and just say thanks and get better acquainted. CoCoRaHS can be done privately via the computer with little direct human interaction, but whenever possible we try to get together to meet each other, share life and weather stories, and strengthen our community of volunteers.

Figure 7. Volunteers at the Fort Collins CoCoRaHS Picnic.

Special events

When schedules allow, CoCoRaHS staff participate in conferences, educational fairs and festivals and even museum exhibits. We were a part of the Jane Goodall "Make a Difference" exhibit at the Denver Museum of Nature and Science. We attend several children's water festivals each year and also attend Farm Shows, fairs, the Colorado Science Convention, Conservation District Annual Meetings and other similar outreach events. These events also become convenient opportunities to recruit new volunteers to join CoCoRaHS.

Figure 8. Students learning about CoCoRaHS at the 2005 Colorado Farm Show

4. EVALUATION—HAVE WE BEEN SUCESSFUL?

During 2005 we have systematically evaluated the data and educational outcomes from these various activities. Clearly, not all volunteers participate in all activities. Required training in setting up and operating a simple weather station has been very successful and most participants respond that they are taught most everything they need to know to get started. An average of 50% of all volunteers continue to remain with the project after receiving initial training. Those who do not usually state "*not enough time*" as the reason for not continuing. This same result has been found in most areas.

Our most dedicated group of volunteers are older adults who are retirement age. But all ages are represented with a modest number of elementary and middle school student participants. The most motivated families and individuals are likely to participate in the special events, while a wider range of interests and backgrounds are present at initial training activities.

The most effective tool for informal science education in CoCoRaHS is our e-mail updates. Extremely positive responses to this form of outreach education are received, and this is listed most often as the main factors in retaining and motivating volunteers. Only a small fraction of participants attend special activities, but these activities have been evaluated very favorably by those who attend. Teacher workshops were also very well received and we were asked to conduct more. They are very resource intensive, however.

Our evaluation results also indicated that the training and support system for volunteers was functioning well and that it was appreciated by the volunteers. In response to the use of CoCoRaHS as a science teaching strategy, two educators in the sample indicated that the program can be a valuable resource for teachers. They reported that they were happy to be able to use a real and relevant science project to teach science as one educator stated: *"Being part of a real science community for the kids rather then a simulated class activity."* CoCoRaHS Sponsors indicated that education was the second highest reason, trailing usage of data, that they have supported CoCoRaHS. Finally, in an evaluation of a series of CoCoRaHS training sessions for volunteers given throughout the year, the attendees typically offered positive comments regarding the meaningfulness of their training experience. A typical response was "*Excellent in-depth information was provided and I appreciated the enthusiasm.*" Learning about the scientific importance of their volunteer work was another noteworthy observation shared by the participants.

Figure 9. CoCoRaHS presentation at the Marble School in Marble, CO.

5. CONCLUSION

CoCoRaHS is proving to be a fun and effective means of engaging the public in precipitation monitoring. The data gathered by CoCoRaHS are not perfect, but they are of consistently high quality suitable for use in many scientific, educational and resource-management applications. CoCoRaHS also provides several ways to successfully share scientific information in a non-threatening way with a wide range (age and education) of children and adults. Participants are learning that measurement and data-sharing are more difficult but more beneficial than they imagined.

6. ACKNOWLEDGEMENTS

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