# Storming the State

## Volunteers Recruited and Trained to Help Measure Precipitation

Weather measurements are used to determine water efficiency for growing crops.

Nolan Doesken uses a frosty pay phone near a general store in Lake County, Colorado, to call in about his work with the Colorado Climate Center. He's on the road storming the state for volunteers for the Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS), a group of lay people who report on precipitation from locations around the state. Doesken, a senior research associate, and his colleague Roger Pielke, professor and state climatologist, piece together information gathered from low-tech projects like CoCoRaHS and high-tech automated weather stations to create a detailed picture of Colorado's complex weather patterns.

The CoCoRaHS project represents the largest network of weather observations in the state. More than 2,000 volunteers have been recruited and trained to measure precipitation for the program. Doesken says, "CoCoRaHS is a kind of weather family. The volunteers span generations. Just yesterday in Montrose, we had a grandfather and grandson team up." After their training, the volunteers receive e-mail that keeps them abreast of how water shortages and excesses are impacting different areas of the state. CoCoRaHS was founded in 1998, with the support of the Agricultural Experiment Station and Cooperative Extension at Colorado State University, in response to the Fort Collins flood of 1997. More recently, the program has played an important part in quantifying drought.

The Colorado Climate Center uses the measurements taken by CoCoRaHS along with data from the more than 50 automated weather stations and collected by dozens of National Weather Service cooperative observers to monitor the state's weather. These networks, along with data from other organizations, allowed Doesken, Pielke, and research coordinator Odie Bliss, as well as other Colorado Climate Center staff and Colorado State University researchers, to respond quickly to the recent drought. Research was made available via the Internet, articles were written, and interviews were given.

"Prior to the drought, the message that we'd been trying to send was that drought is a regular part of life in Colorado. Severe drought is not the once-in-a-lifetime event in any location in the state. Rather, it's the kind of thing that at any location in the state takes place several times in a lifetime. But every drought has a different shape. The one we've just experienced covered the entire state. That's why it hit the headlines, and that's why our message is getting more attention," Doesken asserts.

In researching drought, Pielke says that the Colorado Climate Center has found that as a result of population growth and competition for water "we are more vulnerable today to drought than we would have been if the same precipitation deficits had taken place in the past. Our recommendation is to develop and use our water resources as efficiently as possible in order to reduce this increased risk." Pielke and his team also have done research that shows that the impact of drought is dependent on the effected person, community, or industry. The researchers have developed a color-coded system that shows the impacts from minimal to severe in Larimer County.

Doesken uses agriculture as an example of how weather data are being used to help manage precious water resources more wisely:

Colorado State University

*Knowledge to Go Places*

"In the past, researchers were gathering data to see how much water is lost in transpiration from plants or to evaporation from soils, but now weather measurements are used to determine the best estimates of how water can be used efficiently for growing crops in Colorado. That's one of the reasons for the existence of CoAgMet, the Colorado Agricultural Meteorological Network."

CoAgMet is a joint venture between Colorado State University plant pathology Extension specialists, the Agricultural Research Service Water Management Unit of the United States Department of Agriculture, and dryland agricultural research and involving Extension specialists, some county agents, and a number of other collaborators. It is devoted to collecting localized weather data in irrigated agricultural areas. The Colorado Climate Center has made CoAgMet data available to users via the World Wide Web at http://ccc.atmos.colostate.edu/~coagmet.

Weather data also is being used to take a long view of climate issues. Pielke has been at the forefront of investigating issues like the effects of changes in land use on Colorado's climate. Using data and models, he has ascertained that the presence of large irrigated areas (both lawns and agriculture) in parts of the state have significantly modified weather and climate in these areas. Pielke says, "Many summer days are cooler but more humid and nights are warmer than they would be with the natural landscape of the region."

The Colorado Climate Center monitors climate using a variety of low- and high-tech programs in order to investigate the complex interactions between atmosphere, oceans, continental glaciers, land, and vegetation with the hope of reducing the state's vulnerability to climate variability and change.

The magazine *Colorado Climate* is published four times per year in order to disseminate the climate center's latest studies as well as summaries of recent climate. A subscription form for the magazine is available online at http://ccc.atmos.colostate.edu/magazine.php.

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## The Historical Record

The Fort Collins Weather Station, located on the Colorado State University campus just north of the new transit center, is aging well. Looking at the shiny new fence that surrounds the well-maintained weather equipment, it would be hard to guess that the weather station has been operating without interruption since 1889.

Every 10 minutes, automated measurements of temperature, humidity, wind speed and direction, pressure, solar radiation, and soil temperatures are taken at the station. Every 12 hours, precipitation, snowfall, cloud and sky conditions, visibility, evaporation, winds, temperature, humidity, and other standard variables are measured manually. Some of the techniques used for collecting the data have changed over the years. For instance, soil temperature used to be measured by inserting giant thermometers into the ground, and solar radiation wasn't accounted for at all. However, a number of weather observations are made in very much the same way they were a century ago. These traditional methods maintain consistency, ensuring that measurements don't change with a change in instruments.

In recent years, the construction of the new campus transit center placed the historic station in danger of being dismantled and moved. Fortunately, advocates of the station pointed out the unique quality of the station's historical record. The station at Colorado State and a station in Rocky Ford have produced the longest uninterrupted weather records in Colorado.