NEW MEXICO Climate

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New Mexico Climate

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Cover Photo:
"Playground", by Ted Sammis

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About NMSU's Climate Center

NMSU's Climate Center is home to the state climatologist who helps New Mexicans understand the impact of climate changes on the environment, human health, and agricultural production.

The state climatologist is responsible for archiving weather data and distributing climate information to the public. Unlike meteorologists, climatologists do not provide weather forecasting or up-to-the-minute bulletins. Instead, they use a computerized data collection system to provide statevide weather reports for previous days, as well as for historical information.

The state climatologist puts climate data into a form people can use to make decisions about their lives. During fire season, people use climate data to assess potential fire hazards and to evaluate fire-fighting conditions. Engineers use information about rainfall and flooding to design bridges, culverts, storm sewers, and sanitary sewers. Business owners use climate data to evaluate new business or relocation sites. Farmers use it to anticipate outbreaks of insect pests or crop diseases. People also use climate data when making their recreation and travel plans.

For more information:
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The office of the state climatologist and its head, the state climatologist, are described in New Mexico Statue 75-4-1 through 75-4-4

Water Supply Forecast of Stream Flow Volume

By Ted Sammis* and NRCS web site

The Natural Resources Conservation Service (NRCS) produces a water supply forecast of stream flow volume in the spring and summer. Water supply forecasting is based on the fact that most of the annual stream flows in western North America originates as snowfall that has accumulated in the mountains during the winter and early spring. This snowpack serves as a natural reservoir, storing water during the winter and releasing it during the spring and summer snowmelt seasons. The delay between when the snow falls and when it melts makes it possible for hydrologists to predict snowmelt runoff.

Forecasting is more difficult when, winter, spring, or summer rainfall supply a significant amount of the stream flow volume since it is not easy to predict future rainfall (see article in Summer newsletter 2008). Most water supply forecasts are made using statistical models that mathematically explain the relationship between the predictor variables (snowpack, precipitation, antecedent stream flow, etc.) and the seasonal stream flow volume of interest. Statistical models are relatively simple and straightforward to calibrate and use, but require long historical records (preferably greater than 20 years), where the rainfall and flow of the channel are measured. This is a problem for a lot of ungaged watersheds, especially ephemeral streams that run only intimately. Figure 1 shows the results of what can happen when an ephemeral stream has a rainfall event occur upstream. Only a hydrologic model can simulate and predict this type of rainfall runoff response of a watershed.

◄ Figure1. Sandhill Arroyo Las Cruces,

NM runoff during summer 2008.

Picture by: Joesphine Vasquez, 2008.

Hydrologic models attempt to represent all of the main physical processes affecting the movement of water within a watershed and the generation of stream flow. These hydrologic models are used to delineate the flood zone maps used by the Federal Emergency Management Agency for home flood insurance (see newsletter spring 2000). They operate on a continuous basis using a daily or shorter time step. The main advantage of simulation models is that, by explicitly accounting for physical processes, they have a more complete description of what is happening in the watershed and can potentially make more accurate stream flow predictions, especially under unusual circumstances. The simulation models can be run year-around or for a single event or group of rainfall events and can produce other outputs besides seasonal stream flow volumes, such as full hydrographs, the flows rate (cubic ft /sec) vs. time (minutes, hr) graph. The disadvantages of simulation models are that they require significantly more input data than statistical models, are more difficult and time consuming to calibrate, require more complex output interpretation, and require more database and software infrastructure. Although the use of simulation models is limited at present, they nevertheless have much potential, and their use will increase in the future.

On July 26 and 27 2008, the ruminants of Hurricane Dolly that came ashore at Brownsville, Texas as a Category 1 hurricane hit Las Cruces, Silver City and Ruidoso NM dropping between 3 to 4 inches of rain. This rainfall caused increased runoff and flooding. The National Weather Service predicted that Dolly would produce up to 3 inches of rainfall in the Las Cruces area and the mean rainfall for the area was 2.74 inches ranging from 1.42-4.07 inches. However, no one had up and running hydrologic models to predict the runoff and flooding that would occur from this storm Ruidoso had the worst flooding with meteorologists measuring more than 6 inches of rainfall in the mountainous area causing the Rio Ruidoso River to overflow its banks at midnight July 26, 2008.

Consequently, flood control consists of two parts, prediction of rainfall events and amounts and prediction of rainfall runoff in relationship to the carrying capacity of the river system. Most hydrologic models are built and run in real time for large river system such as the Columbia River in Washington State. New Mexico State University is working on developing a real time hydrologic model for the Rio Grande River but it will be in the future to have models for small watersheds such as the one that is drained by the Ruidoso River. Rivers will always overflow their banks and that is why flood insurance is needed for houses and structures that exist in the flood plain area.

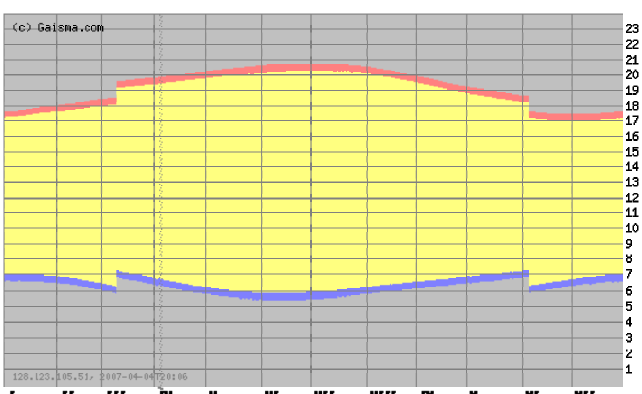
*Professor, Plant and Environmental Sciences, New Mexico State University

Solar Energy in New Mexico

By Ted Sammis *

The sun provides the earth with a large amount of energy (1.7 *10^22 Joules of energy in 1.5 days which equals all the recoverable energy from oil. This energy drives the oceanic and atmospheric currents, the cycle of evaporation and condensation that drive the hydrologic cycle and the photosynthesis's food production system. The problem with the sun's energy source is that it is dispersed over a large area and is not concentrated where is can readily be convert to human use. The second problem is the photovoltaic conversion efficiency ranges from 10% to a maximum of 32% (Cabtree and Lewis 2007) but as the conversion efficiency increases so does the cost.

The sun shines in Las Cruces New Mexico an average of 350 days each year with an average day length ranging from 10 hr in the winter and 14 hr in the summer (Figure 1). Consequently, southern New Mexico is a great place for renewable energy to be produced by photovoltaic conversion and the cost should be around 17 cents/kw hr. Santa Fe has only 300 days of sunshine and consequently the cost would be around 20 cent per kw-hr. The current cost of electricity for Las Cruces is 11 cents per kw-hr and for Santa Fe 9.8 cents per kw-hr. Consequently, without federal and state subsidies, the cost is not comparable with oil based electricity.



◄ Figure 2. Plot of sunshine hr for Las Cruces, NM

Darkness Dawn Sunshine Dusk

References

Crabtree , G. W. and n. S. Lewis. 2007. Solar energy conversion. Physics today march 2007 37:42.

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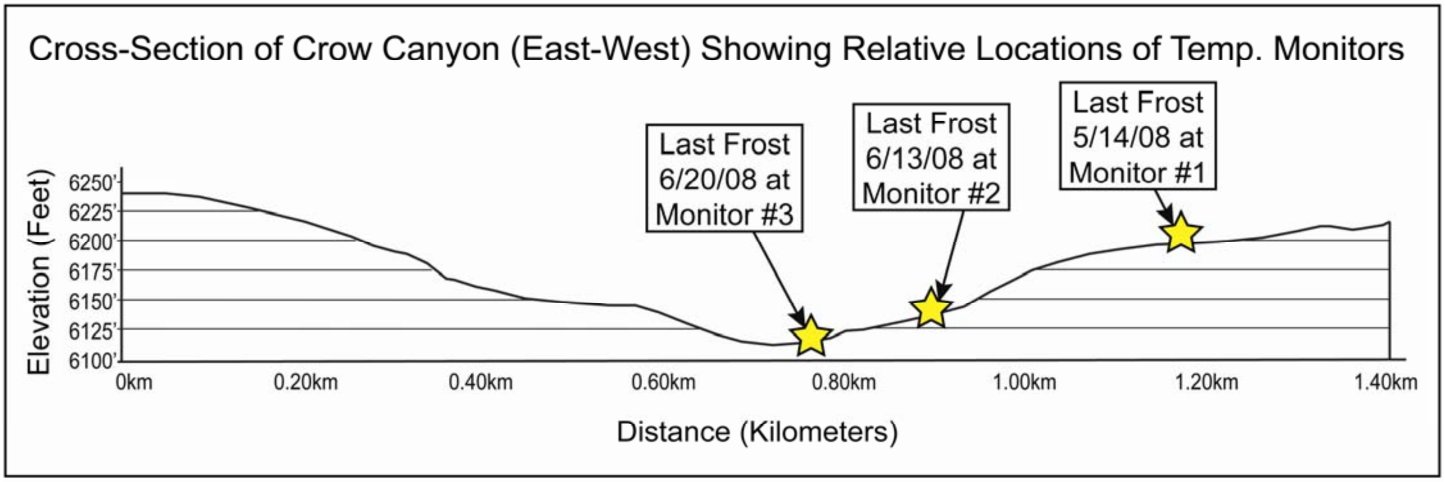
Pueblo Farming Project
Temperature and Climate Studies Shed Light on Ancient Farming
by Benjamin Bellorado*



Everyone knows temperature is important in farming—how many home-gardeners have lost their tomato plants to a late spring or early fall frost!—but did you know that just a few feet in elevation can have a huge effect on temperature, spelling the difference between a successful crop and a failed harvest? Farmers in the Mesa Verde region have long been aware of the phenomenon known as "cold-air drainage," that is, the tendency for cooler air to "drain off" of canyon rims and settle in the canyon bottoms below. For the ancestral Pueblo farmers, cold-air drainage was a critical factor in growing the corn and other crops upon which their very survival depended.

Many varieties of corn require roughly 120 frost-free days, from planting to harvest, to mature. So in an area where the average length of the growing season ranges from 110 to 150 days, even very small variations in the number of frost-free days can have dramatic effects on agricultural productivity. Pueblo farmers during ancient times undoubtedly considered the interrelated factors of cold-air drainage and growing season when choosing where to locate their farm fields.

As part of the Pueblo Farming Project, Crow Canyon researchers are measuring variations in temperature in two study transects—one located at the head of Crow Canyon (on the Center's campus) and the other at the head of Goodman Point Canyon, where we are currently conducting excavations at several ancestral Pueblo sites. Both transects begin on the canyon rim, dip down into the canyon bottom, and continue up the opposite rim. In the spring of 2008, researchers placed a total of 10 temperature monitors at intervals along the transects. The monitors record temperature readings every hour, and we plan to leave them in place for several years. In addition, a large weather station is providing measurements of the accumulated precipitation on the Crow Canyon campus. The data recorded by the temperature monitors and weather station should help us understand how ancient people chose locations in which to grow corn, beans, and other crops.

So what have we learned so far? Well, we have already seen that, indeed, cold-air drainage does occur at Crow Canyon—and to an extent that it could have dramatically affected agricultural productivity. Although the results are preliminary, data downloaded from three of the monitors on campus indicate that the growing season in the shallow canyon bottom, where cold air tends to pool, can be at least one-and-a-half months shorter than the growing season in farmable areas adjacent to the canyon rims (see figure). It is likely that a similar phenomenon occurs at Goodman Point.

This raises an interesting question: Why did ancient farmers, who surely knew about the risk associated with cold-air drainage, choose to locate one of their farm fields in the shallow canyon bottom on Crow Canyon's campus? We became aware of this field only after we discovered an ancient agricultural checkdam in the very location where we chose to place one of our own garden plots as part of the Pueblo Farming Project. Of the four plots, this one has been the most productive, possibly because it has the best soil and retains moisture. It is likely that this same location was chosen by Pueblo people for a "secondary field" planted as a buffer against potential crop losses in fields located on the warmer, but drier, canyon rim.

At different times, the size of the areas affected by cold-air drainage may have expanded or contracted due to shifts in the overall climate of the region. Monitoring the character of cold-air drainage at Goodman Point and on the Crow Canyon campus will help us understand how people responded to and viewed climatic shifts through time across the Mesa Verde region and beyond.

* Laboratory Program Coordinator, Crow Canyon Archeological Center

CoCoRahs News

Because Every Drop Counts

By: Ashley Tolman* & Leeann DeMouche**

New Mexico has a large array of geographic variability in precipitation (rainfall, hail, and snow). In some portions of the state there is a great deal of rainfall, while, at the same time, other areas remain dry. Since New Mexico joined CoCoRaHS in 2005 more information on precipitation variability has been recorded within the state, but in order to increase the efficiency of the program, the network needs to grow. The Rio Grande Basin Initiative realizes this and with the help from the USDA-CSREES Efficient Irrigation for Water Conservation Rio Grande Basin Initiative grant the New Mexico CoCoRaHS will be able to extend its network area.

The primary objectives for the New Mexico CoCoRaHs network are to first of all, increase the amount of precipitation data available throughout our state by encouraging volunteer weather observers. Secondly, provide accurate high-quality precipitation data for our many end users on a timely basis. So, in simpler terms, there needs to be more people involved all over the state collecting data on the amount of precipitation that occurs in each specific area.

In the last year 72,000 people have moved into New Mexico from other states. Most of these new residents have never lived in the arid or semi-arid desert and are not used to an average annual rainfall of 7 inches. Who better to target for involvement in an educational statewide project than these new residents.

The CoCoRaHS team will be developing water conservation packets that will be distributed through the Welcome Wagon and Newcomer's program or through the local real estate offices in cities throughout NM. The packets will include lots of water conservation information, such as the Office State Engineers Waterwise materials on evaporative coolers, clothes washers, ultra low flow toilets, and Agua Action, just to name a few. Additionally, in the packet will include a coupon for one free rain gauge (a retail value of over $28.00). Once the new resident has completed a 90 minute training session and joined the CoCoRaHS network they will receive their free rain gauge. Of course we are not only offering rain gauges to new residents existing residents are very welcome to join the program.

The USDA funding will also allow us to start collecting hail data again. For the past year and half we were no longer able to distribute hail pads, but with this new funding we will be able to make and distribute hail pads to new and existing CoCoRaHS observers who are willing to collect this type of quantitative data.

Additionally, the CoCoRaHS trainings will be available in English and Spanish. We are working with NMSU ICT to record the trainings in English and Spanish and place them up on the YouTube NMSU website. Trainings should be available on YouTube by January, 2009 at http://uk.youtube.com/newmexicostateu.

Right now there are over 700 rain gauges throughout New Mexico. However, only half of the observers are recording their rainfall. We feel that many are still collecting data, but the data is not being recorded into the system. We have started a huge effort to contact current CoCoRaHS observers who have not recorded any observations since January 1, 2008. We have made progress in getting some of these observers back up and running and recording their observations, because in New Mexico "*Every drop counts*."

If you're interested in joining the CoCoRaHS family please visit our website at http://www.cocorahs.org and click on the state of New Mexico or contact Leeann DeMouche (ldemouch@nmsu.edu) the CoCoRaHS State Coordinator.

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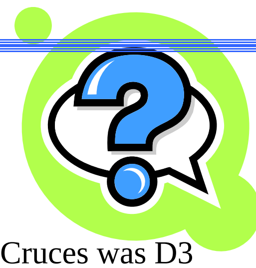
Questions for the New Mexico Climate Center:



Question: How much rain does it take for a drought to go away?

Answer by Dr. Ted Sammis: On July 1, 2008 the drought index in Las Cruces was D3 extreme and in Clovis it was D1 moderate. By July 30, 2008 the designation in Las Cruces changed from D3 to no drought and in Clovis the designation had changed from D1 to D0 which is dry but not as dry as a D1 classification . The change occurred because 5-6 inches of rainfall occurred during that time period in Las Cruces and 4-5 inches in Clovis. Consequently, it requires more rainfall to occur in a wetter area (Clovis mean annual rainfall 17.92) to declare that the drought has disappeared compared to a drier area (Las Cruces mean annual rainfall 9.23 inches) In Las Cruces the rainfall was 3-4 inches above normal for that month and in Clovis it was only 2 inches above normal. Consequently, for a drought to be declared to have ended if it is D3 extreme, will require 3-4 above the normal rainfall for the time period to create the excess rainfall needed to fill the soil in the root zone.