

Los Alamos Monitor

October 18, 2009

Observatory on Valles Caldera to play major role in climate research

How the CZO program may help answer climate impact questions

By Dave Menicucci

The looming 100-foot instrumentation tower nestled among the pines in the southwest corner of the Valles Caldera National Preserve may help scientists answer some of the most important questions of our age. Data from this tower will be used to foretell how climate change might affect Earth's life processes. Predicting these impacts has been a vexing problem because there is no precedent for a warming Earth with extensive human habitation.

This experimental site, called a Critical Zone Observatory, is part of a nationwide data collection system that has been measuring the characteristics of the Critical Zone of the biosphere. The CZ is defined as the part of the Earth that contains most biological life and it ranges roughly from treetop level to the bottom of the ground-water layers, sometimes as deep as a thousand feet.

Scientists believe that by understanding the CZ they can more accurately forecast the Earth's life-processes, such as hydrological systems, the biosphere and biological habitats.

Water

Ground and surface water are resources of special interest in the semi-arid Southwest. New information emerging from the CZ project is suggesting a surprising interaction between forest thinning and ground water resources and stream runoff.

Bob Parmenter the chief scientist at the preserve, explained this critical balance. "Too dense a forest will trap snow on the tree limbs, which allows the ice to sublimate directly to the air," he said. "With too little forestation, the snow hits the ground, but the lack of shade allows the sun to quickly melt it and it evaporates. In both cases, the water does not seep into the ground or flow to the streams. This implies that there is an optimal forest density for this area, which the CZO project will help us to establish."

The University of Arizona is the lead research organization for the CZO project, which recently received a \$4.37 million National Science Foundation grant to expand the program to collect more data and extend its operation for another five years.

Paul Brooks, professor of hydrology, is one of the principal investigators and he lauded the Valles Caldera site. "The preserve is wonderful," he said. "First, it has controlled access, so

vandalism is minimal. Second, there is a documented history of use of the area, which is important as we interpret the scientific data. Most importantly, it is at the southern end of the cold, temperate snow pack, an area where we traditionally observe significant climatic variability.” He explained that this variability creates interesting situations to study the various interrelated systems in the critical zone.

Brooks believes that the CZO project, which is composed of six sites across the country and two more in development, will help scientists understand more thoroughly the interactions between the entities of the atmosphere, the ground surface and the subsurface. “Ultimately, we expect to develop accurate bio-physical predictive models that will replace the statistical ones we have now.”

This is an important objective because statistical models are developed from historical trends, which are assumed to be repetitive. If the assumption is true, then a statistical model can accurately forecast future activity. However, today’s climatic events are unprecedented, thus the past may not be an accurate indicator of the future.

Brooks said that “bio-physical models will be based on an understanding of the fundamental relationship between various physical entities.” Thus, a unique set of inputs — ones that have never been observed historically — will render a unique prediction, whether or not there is an historical precedent.

For example, currently stream runoff levels are predicted with a statistical model, one based on a 100 years of snowpack data. However, forest densities have increased considerably over the past 25 years and sometimes the densities are radically reduced by fire. A bio-physical model, which incorporates the complex relationship between forest density and groundwater, has a better chance than a statistical one for accurately predicting runoff for specific watershed conditions.

Collaboration and education

The critical zone is a complex region on the Earth with many interrelated entities. Thus, the project incorporates a wide range of scientific capability from various institutions across the country. Los Alamos National Labs will provide ecological, geological and hydrometeorological expertise.

The CZO project will implement a substantial education effort. “Our goal is to provide fundamental scientific training about the critical zone for students in kindergarten through graduate school,”

Brooks said. “We will especially concentrate on helping teachers to experience the thrill of scientific discovery in the hope that they will pass it on to their students.”

Parmenter plans a robust science education program using the newly leased educational complex located within the Valles Caldera office complex in Jemez Springs. “We will be bringing in teachers and students during the summer, housing them here and then taking them out to the preserve for hands on experiments,” he said. “They will make observations and compare them with measurements that we will take from the instruments at the CZO tower and other places. We believe these interpretive sessions will be enlightening.” Parmenter is currently planning next summer’s programs and signing up interested participants.

While the Valles Caldera has been the focus of intense public scrutiny and controversy over the past year, its science programs under Parmenter's capable tutelage have been steadily progressing. The CZO project is one of the preserve's premier scientific achievements and its benefits are expected to be realized for years to come