A Team Strategy to Model Global

Scientists in the College are anchoring a worldwide task force of scholars that is exploring the interplay of weather phenomena that lead to El Niño, global warming, and other extreme climate conditions.

By Stuart Wolpert

"The good news," said Nobel Peace Laureate Al Gore about responding to global environmental challenges, "is that we know what to do. We have everything we need now to respond."

UCLA is playing a major role in that response, confronting the complex issues of environmental change through leadership of a global program of 150 scientists from 40 universities in nine countries who participate in research to gain new understanding of the Earth's climate and the interconnected systems of oceans, the atmosphere and land.

The program, called VOCALS (the VAMOS Ocean-Cloud-Atmosphere-Land Study), explores the southeastern Pacific, the marine area off South America's west coast that is critical to El Niño development. Here the interplay among low clouds, strong low-level winds, coastal ocean currents, surfacing of deep water, the Andes Mountains, aerosols and other factors shape regional climate and affect global weather in ways that are poorly understood.

"Our research should produce a better understanding of the southeast Pacific Ocean system and improve our global computer climate models, which would lead to more confidence in climate forecasts, including predictions about global warming," said C. Roberto Mechoso, a UCLA professor of atmospheric and oceanic sciences and chair of VOCALS.

"Models currently used for climate change studies have systematic errors concerning the southeastern Pacific Ocean," said Mechoso. "We hope our research will get rid of, or at least greatly decrease, these uncertainties."

The "El Niño-Southern Oscillation," better known simply as El Niño, is a warming of the ocean current off the South American coast that is associated with weather extremes in locations around the world, including such contrasting outcomes as flooding in California and scorching drought in Tanzania. These devastating effects, and the irregularity of the phenomenon, makes predicting El Niño of prime interest to atmospheric scientists.

Although global warming is not directly responsible for El Niños, recent studies suggest that higher ocean surface temperatures can enhance the El Niño phenomenon. Whether El Niño occurrence changes with climate change is a major research question.

C. Roberto Mechoso

Climate

Variations in the southeast Pacific climate affect rainfall and temperature worldwide, directly or indirectly, Mechoso believes, but how the system works is not well understood and therefore cannot be modeled or predicted accurately.

"Despite the great importance of the ocean-cloud-atmosphere-land system to the Earth's climate, this system in the southeast Pacific has been sparsely observed," Mechoso said. "With VOCALS, that is changing drastically."

Will VOCALS increase our understanding of how much global warming will occur, and over what period of time?

"Absolutely," said Mechoso, an expert on El Niño who studies the coasts of Ecuador, Peru and Chile. "We may also produce a better understanding of the dynamics of El Niño. The relation between the eastern Pacific and El Niño is strong. El Niño develops in the eastern Pacific, so when the eastern Pacific is not well represented in climate models, El Niño is not well represented in the models either."

VOCALS has a scientific modeling program, headed by Mechoso, which seeks to improve model simulations of key climate processes, and an experimental field component, headed by Robert Wood, assistant professor of atmospheric sciences at the University of Washington. This intensive experimental field program is measuring—using five aircraft and two research ships containing scientific instruments—how thick and deep the clouds are, where and why they open, and a variety of other elements to answer key scientific questions related to the climate system of the southeast Pacific region.

"There is tremendous analysis and modeling work that will go along with the field project," Mechoso said.

Other UCLA faculty participating in the research along with Mechoso include James C. McWilliams, UCLA's Louis B. Slichter Professor of Earth Sciences; Alex Hall, assistant professor of atmospheric and oceanic sciences; and Bjorn Stevens, professor of atmospheric and oceanic sciences.

Mechoso's own research project within VOCALS, in collaboration with the National Center for Environmental Prediction, aims to improve the model that is used by the United States for seasonal climate prediction. The "V" in VOCALS represents an acronym: VAMOS, or Variability of the American Monsoon Systems. Mechoso was the first chair of this panel of the World Climate Research Program, which identified the eastern Pacific as an area where improvement in climate models is essential.

The scientists in VOCALS are also trying to learn more about the role of aerosol in cloud behavior and climate. Particles in the atmosphere can directly influence radiation from the sun but can also have indirect influences on solar radiation by affecting cloud formation. The United Nations' Intergovernmental Panel on Climate Change (which shared the 2007 Nobel Peace Prize with former Vice President Al Gore) has emphasized the need to reduce the overall uncertainty in the calculation of climate-forcing by aerosol.

"The role of aerosol in climate is very complex and we are working hard to capture aerosol effects in climate models," Mechoso said.

VOCALS is supported primarily by federal funding from the National Science Foundation and the National Atmospheric and Oceanic Administrations. Additional support comes from the U.S. Department of Energy and the Office of Naval Research, as well as Chile, Peru and the U.K. Meteorological Office, which provided a research aircraft.

"I believe we have the right questions and the right hypotheses to guide our work," Mechoso said. "We will learn how the southeastern Pacific Ocean system works and find out ways to improve the performance of our climate models."