Link discovered between Montana weather, ocean near Peru

July 22 2011, By Evelyn Boswell

A Montana State University researcher who analyzed 100 years of data has found a significant link between extreme Montana weather and the ocean temperatures near Peru.

Montanans who want to know what to expect from the weather should look to the Pacific Ocean in the fall or maybe find a way to chat with some Peruvian fishermen, according to Joseph Caprio, professor emeritus in MSU's Department of Land Resources and Environmental Sciences and former Montana State Climatologist.

If the average surface temperature of the ocean near Peru is warmer than normal from November through March, fishing off the coast of Peru will be poor and Montana will experience El Nino from the following December through June, Caprio said. El Nino generally means Montana will be warm and dry.

If the average surface temperature is cooler than usual from November through March, fishing off the coast of Peru will be good and Montana will have a cool, wet spring, like the one experienced this year during La Nina, Caprio said. He added that weather in different areas of the country responds differently to El Nino or La Nina.

Caprio said Peruvian fishermen knew hundreds of years ago that ocean temperatures affected their livelihood. And scientists have long known that weather around the globe is linked to El Nino in different parts of the world. Meteorologists with the National Ocean and Atmospheric

Administration make long-range forecasts by monitoring sea surface temperatures, atmospheric pressure, wind, air temperatures and cloudiness in various areas of the Pacific Ocean.

Caprio focused on the sea-surface temperatures in the area that's associated with Montana weather. That area is off the Peruvian coast and near the equator. It covers about 550 miles from north to south and 4,100 miles east to west.

Caprio specifically wanted to determine the effect of El Nino on extreme daily temperatures and precipitation in Montana.

"Since El Nino sea surface temperature anomalies tend to persist for many months and have predictable climatic associations, it is prudent to undertake research to understand how El Nino affects extremes of weather for individual locations in order to provide useful information for decision makers," Caprio said in a paper he published in the *Intermountain Journal of Sciences*.

Compared to normal years, El Nino years tend to have about 20 percent more days with extreme high daytime temperatures, 20 percent fewer days with extreme low nighttime temperatures and 20 percent fewer days with high precipitation amounts, Caprio said.

"An increase or decrease of extreme daily weather occurrences can impact natural resources and a wide range of human activities including agriculture, forestry, recreation, construction and other businesses," he added.

Luther Talbert, a professor in MSU's Department of Plant Sciences and Plant Pathology, reported the impact of a long-term trend toward warmer temperatures on hard red spring wheat in a paper he co-authored with other ag researchers at MSU. Published last year in the journal *Crop*

Science, the paper showed that warmer temperatures are changing the environment for spring wheat production and will impact the goals of breeding programs.

That study looked at weather data and crop performance at six Agricultural Research Stations across Montana. From 1950 to 2007, the mean annual temperatures at five of the six sites increased significantly. March temperatures increased significantly at all sites, and planting dates became significantly earlier over time. This has led to earlier planting and a potentially longer growing season. Conversely, hotter temperatures in summer are causing earlier leaf senescence, thus shortening the time plants have to produce plump grain.

"The projection of increasing temperatures suggests the need for management and breeding strategies to ensure productivity of hard red spring wheat in the northern Great Plains," the paper said.

Caprio conducted his study by analyzing the relationship between two databases that each provided 100 years of information. One database gave the air temperature and precipitation as recorded every day from 1901 to 2000 on the MSU campus. The other database came from the Japanese Meteorological Agency and gave the monthly temperature of the ocean's surface between the latitudes of 40 degrees north and 40 degrees south and the longitudes of 150 degrees west and 90 degrees west. Those temperatures were taken in a variety of ways over the years - some by ship, others by buoys and satellites, Caprio said.

Caprio specifically compared MSU temperatures and precipitation between Dec. 3 and June 23 to average sea-surface temperatures between November and March. The study period included 50 normal years, 25 El Nino years and 25 La Nina years.

To analyze the data, Caprio used a statistical method he developed years

ago called the "iterative chi-square method." It's different from most other techniques for studying climate impacts because it uses daily temperatures and precipitation, Caprio said. He added that he has proven the method in previous studies that considered the effect of daily temperatures and precipitation on apple, peach, grape, sweet cherry and apricot production in British Columbia, tree ring growth in Arizona, wheat production and winterkill in Montana, and climate variation in the Northwest.

Caprio said he continues to conduct such research because he has a curiosity to discover and wants to share his research methods with the scientific community, contribute to human knowledge, assist researchers in determining the effect of daily temperature and precipitation on agriculture natural resources and human activity, and emphasize the importance of long-term daily weather observations.

Provided by Montana State University