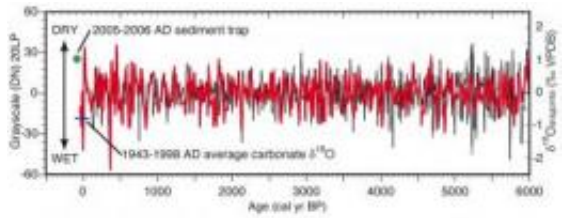
6,000-year climate record suggests longer droughts, drier climate for Pacific Northwest

February 22 2011



Measurement of oxygen isotope ratios (red) and grayscale (black) arranged to show drought cycle duration and intensity with 20th century wet period indicated. Credit: Mark Abbott

University of Pittsburgh-led researchers extracted a 6,000-year climate record from a Washington lake that shows that the famously rain-soaked American Pacific Northwest could not only be in for longer dry seasons, but also is unlikely to see a period as wet as the 20th century any time soon. In a recent report in the *Proceedings of the National Academy of Sciences*, the team linked the longer dry spells to the intensifying El Niño/La Niña climate pattern and concluded that Western states will likely suffer severe water shortages as El Nino/La Nina wields greater influence on the region.

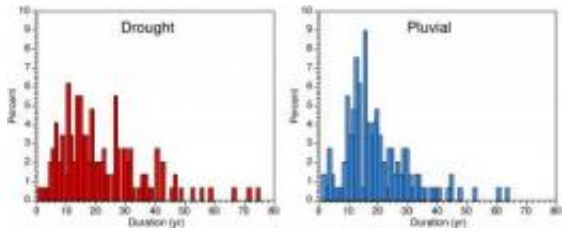
The researchers analyzed a sediment core from Castor Lake in north central Washington to plot the region's drought history since around 4,000 BCE and found that wet and dry cycles during the past millennium have grown longer. The team attributed this recent deviation to the

irregular pressure and temperature changes brought on by El Niño/La Niña. At the same time, they reported, the wet cycle stretching from the 1940s to approximately 2000 was the dampest in 350 years.

Lead researcher Mark Abbott, a Pitt professor of geology and planetary science, said those unusually wet years coincide with the period when western U.S. states developed water-use policies. "Western states happened to build dams and water systems during a period that was unusually wet compared to the past 6,000 years," he said. "Now the cycle has changed and is trending drier, which is actually normal. It will shift back to wet eventually, but probably not to the extremes seen during most of the 20th century."

Abbott worked with his former graduate student, lead author and Pitt alumnus Daniel Nelson, as well as Pitt professor of geology and planetary science Michael Rosenmeier; Nathan Stansell, a Pitt PhD graduate now a postdoctoral researcher at Ohio State University; and Pitt geology and planetary science graduate student Byron Steinman. The team also included Pratigya Polissar, an assistant research professor at Columbia University's Lamont-Doherty Earth Observatory; Joseph Ortiz, associate professor of geology at Kent State University; Bruce Finney, a professor of geology at Idaho State University; and Jon Riedel, a geologist at North Cascades National Park in Washington.

The team produced a climate record from the lake mud by measuring the oxygen isotope ratios of the mineral calcite that precipitates from the lake water every summer and builds up in fine layers on the lake floor. More calcite accumulates in wet years than in dry years. They reproduced their findings by measuring grayscale, or the color of mud based on calcite concentration, with darker mud signifying a drier year.



Duration of dry and wet cycles by percentage over 6,000-year period. Credit: Mark Abbott

The record in the sediment core was then compared to the Palmer Drought Severity Index, which uses meteorological and tree-ring data to determine drought cycles dating back 1,500 years, Abbott explained. The Castor Lake core matched the Palmer Index reconstructed with tree-ring data and expanded on it by 4,500 years, suggesting that lakebeds are better records of long-term climate change, the authors contend.

Analysis of the sediment core revealed that the climate of the Pacific Northwest fluctuated more or less evenly between wet and dry periods for thousands of years, the researchers wrote. Droughts tended to be lengthier with 25 percent of dry periods during the past 6,000 years persisting for 30 years or more and the longest lingering for around 75 years. Wet periods tended to be shorter with only 19 percent lasting more than 30 years and the longest spanning 64 years.

But since around 1000 AD, these periods have become longer, shifted less frequently, and, most importantly, ushered in more extreme conditions, Abbott said. The two driest cycles the researchers detected out of the past 6,000 years occurred within only 400 years of each other—the first in the 1500s and the second during the Great Depression. Wet periods showed a similar pattern shift with five very wet eras crammed into the past 900 years. The wettest cycle of the past 6,000 years began around the 1650s, and the second most sodden began

a mere 300 years later, in the 1940s.

The change in cycle regularity Abbott and his colleagues found correlates with documented activity of El Niño/La Niña. When the patterns became more intense, wet and dry cycles in the Pacific Northwest became more erratic and lasted longer, Abbott said.

Provided by University of Pittsburgh