Tropical rain may have formed Utah's Great Salt Lake

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(Phys.org)—Between 20,000 and 14,000 years ago, the deserts in the American Southwest were covered with enormous lakes. How all that water got there has long puzzled Earth scientists, but new work by a group of scientists that includes a Stanford climate researcher could provide an answer.

For decades, scientists believed that the 3-kilometer-thick ice sheet that covered much of North America split the jet stream that runs eastward across the northern United States and Canada, redirecting the path of Pacific storms southward over the western states.

Over time, these diverted storms were thought to have dumped enough precipitation to create lakes that covered about a quarter of both Nevada and Utah. The largest and best known of these lakes are Lake Bonneville, whose remnant is the Great Salt Lake, and Lake Lahontan in Nevada.

"If the Pacific storm track hypothesis is correct, then we would expect to find wet conditions along that storm track from the coast inland," said Noah Diffenbaugh, an assistant professor of environmental Earth system science at Stanford's School of Earth Sciences and center fellow at the Stanford Woods Institute for the Environment. "But this new analysis shows that the Pacific coast didn't have its wettest period until thousands of years after the earliest of the wet times in the Great Basin."

30 years of data

The scientists reached this conclusion through a combined analysis of ocean sediments and dry western valleys and lakebeds collected over the past 30 years, pollen buried in marine sediments and the results of published climate model experiments. The work appears this week in the journal Science.

With a diverted jet stream ruled out, the group hypothesizes that the precipitation came from the tropics. Southern California coastal wet periods match the progression of lake formations inland, suggesting that rain-carrying storms originating in the tropical Pacific, southwest of Mexico, delivered water north to the Great Basin. Storms from the Gulf of Mexico may also have contributed.

The research team included scientists from Stanford, Texas A&M University, Columbia University, University of California-Santa Cruz, Hokkaido University of Japan, Brown University and the U.S. Geological Survey.

"We think that the extra precipitation may have come in the summer, enhancing the now weak summer monsoon in the desert southwest. But we need more information about what season the storms arrived to strengthen this speculation," said Mitchell Lyle, a professor of oceanography at Texas A&M University and lead author of the study.

Testing a new hypothesis

There are two complementary ways to go about confirming the new hypothesis, Diffenbaugh said. One approach involves examining physical data, such as the chemistry of dried-up lakebed sediments to search for the telltale chemical signatures of the specific air masses that might have filled them. Another approach involves using mathematical models of the atmospheric and oceanic circulations to test how they would behave in a glacial state, which could guide searches for physical data.

Understanding ancient water cycles in the Great Basin and elsewhere helps scientists better understand the mechanics of climate change past, present and future, Diffenbaugh said. Researchers use the same climate models to investigate past climate systems as they do to predict how factors such as human emissions of greenhouse gases and aerosols will affect water availability in the decades ahead.

"The wet glacial conditions in the Great Basin are an interesting climate problem, in part because it was an important time in the arrival of humans in North America," Diffenbaugh said. "This period also helps us to understand climate in the coming century, when we expect not only further global warming but also changes in water demand in the western U.S. arising from increasing population and urbanization. Using geologic data to evaluate climate model simulations of the past helps us to understand how the climate system responds to different types of changes, and that helps us evaluate predictions of the future."

Provided by Stanford University

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