

# Scientists track warming trend in northwestern North America

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A new Montana State University study says that weather, especially in late winter and early spring, is getting warmer in northwestern North America.

The research, published in the January issue of "*Climatic Change*," found that the coldest daily temperatures recorded in Bozeman, Mont., and Coldstream, British Columbia, have occurred less often over the past several decades. Extreme cold nighttime temperatures have become less frequent, and extreme warm nighttime temperatures have become more frequent at a rate of about one percent per year or 10 percent per decade. The greatest warming occurred during late February to March and late July to August.

The research sites are 500 miles apart and on opposite sides of the Continental Divide, but their climate changes tend to be remarkably similar, said Joseph Caprio, professor emeritus and former Montana State Climatologist in MSU's Department of Land Resources and Environmental Sciences and lead author of the "Climatic Change" paper.

The discoveries may interest scientists who study Glacier National Park, because the park lies halfway between the two sites, Caprio added. The findings also lend support to prior research.

"The close correspondence in the warming at both locations is consistent with several previous studies that indicated a pronounced winter to early spring warmup in northwestern North America since the mid-1900s,"

Caprio and two collaborators wrote in their paper.

Caprio retired from MSU in 1993, then became a visiting scientist at Canada's Pacific Agriculture and Agri-Food Research Centre in the Okanagan Valley where Coldstream is located. Harvey Quamme, one of his collaborators, is with the Agriculture and Agri-Food Research Centre in Summerland, British Columbia. The other collaborator, Gallatin Valley native Kelly Redmond, works at the Atmospheric Sciences Division, Western Regional Climate Center of the Desert Research Institute in Reno, Nev.

The researchers started their study by compiling daily temperatures recorded in Bozeman and Coldstream over 54 years. Bozeman's temperatures were recorded from 1947-2000 at a weather station on the MSU campus. Coldstream's temperatures were recorded from 1938-1991 at a weather station on a ranch. The records were transferred years ago from paper to punch cards to modern computers, Caprio said.

The scientists then compared the changes between a 36-year period and a more recent 18-year period for each site. For Bozeman, those periods ran from 1947-1982 and 1983-2000. For Coldstream, they ran from 1938-1973 and 1974-1991.

The researchers looked at different periods for Bozeman and Coldstream, because the computer analysis was first done for Coldstream and then for Bozeman, Caprio said.

To analyze the temperature changes, the scientists used a statistical procedure called the "iterative chi-square method." Caprio originally developed the technique to understand the effect of daily weather on winter wheat and rangeland production in Montana. He later applied the method to study the effect of daily weather on apple, grape, apricot, peach and sweet cherry production in the Okanagan Valley. He also used

it in the Laboratory of Tree Ring Research at the University of Arizona to determine how daily temperature and precipitation affected the annual width of tree rings.

The iterative chi-square method is different from some other techniques for studying climate change because it uses daily temperatures, Caprio said. Scientists can use the procedure to discover daily and weekly significance in addition to monthly and annual trends.

Dan Fagre, a research ecologist based in Glacier National Park, said he looked forward to reading Caprio's paper. The park once had 150 glaciers, but it now has 25 and scientists are predicting that all will be gone by 2030. Eighty-four percent of the ice and perennial snow fields in the park have disappeared. Fagre noted that a glacier is ice that covers at least 25 acres.

The status of glaciers is significant, Fagre added.

"Glaciers reflect change over decades," he said. "If you are seeing a change in glaciers, it's not just a couple-year trend. It's part of a long-term trend. We consider them to be good indicators of change within the mountain system."

Source: Montana State University

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