Climate mapping algorithm shows temperatures rising, especially daily lows

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Credit: Oregon State University

Oregon State University's new maps of 30-year U.S. climate "normals" show the area east of the Rockies is getting wetter, the Southwest is getting drier, and temperatures are inching upward—with daily lows rising faster than daily highs.

"When we publish the new normals every 10 years, we're taking away one decade from a 30-year period and adding another, which means the changes we see are subtle," said geospatial climatologist Chris Daly, a professor in the College of Engineering and the founding director of OSU's PRISM Climate Group. "But temperatures are definitely creeping up, and daily minimum temperatures are increasing faster than the maximums."

PRISM stands for Parameter-elevation Regressions on Independent Slopes Model, and the 30-year normals are the climate group's signature product, one that is "uniquely accurate and detailed," Daly says.

"These maps are the flagship of our suite of digital weather and climate datasets that seamlessly cover the entire lower 48 states and are downloaded tens of thousands of times each day and used everywhere," he said. "PRISM data sets are used by many government agencies including NOAA, the EPA and NASA and the departments of Defense, Energy and the Interior. The private sector relies on PRISM data too, in a broad range of applications that include agriculture, hydrology, engineering, ecology and economics."

Private citizens can also use the maps to check average conditions in, say, their hometown. All it takes is going to the normals page and selecting the data and month of interest, and the applicable color-coded map pops up on the screen.

PRISM is a computer model, developed by Daly in 1991 when he was a Ph.D. student at Oregon State, that digitally mimicked the techniques used by 20th-century climatologists who hand-drew climate maps for the U.S. Department of Agriculture's Natural Resources Conservation Service.

Working in concert with NRCS hydrologist/climatologist Phil Pasteris of

Tigard, Daly helped "usher the USDA into the digital world" by creating a computerized replacement for a process so time-consuming that climate maps hadn't been updated in nearly 30 years, Daly said.

With funding from the NRCS, PRISM released its first 30-year normals, for the period from 1961 to 1990.

Since then PRISM, part of the OSU-based Northwest Alliance for Computational Science & Engineering, has published updated normals every 10 years, each time adding data and modeling from the most recent decade and dropping the least recent. This latest update of the normals, which covers the years 1991-2020, was sponsored by the USDA Risk Management Agency, which oversees the federal crop insurance program.

"What we try to do every time is improve on the technology and our data inputs to make the normals as close as possible to the current state of knowledge of the average spatial patterns of climate," said Daly, chief scientist for the alliance. "NOAA is the official purveyor of climate change statistics and we stay out of that. Our focus is on the spatial aspect and creating a seamless coverage of climate patterns across the continental United States. This year, our fourth time doing it, we made a big push to add new data sources from new weather station networks."

PRISM added 9,000 precipitation stations, for a total of 26,600; 3,000 temperature stations, bringing the total to 19,500; 2,400 dew point stations, for a total of 6,400; and 2,800 vapor pressure deficit stations, increasing that total to 6,400.

Solar radiation was added to the climate normals for the first time, thanks to a three-year collaboration between the PRISM group and David Rupp of the OSU College of Earth, Ocean, and Atmospheric Sciences. Solar radiation data reached PRISM via a variety of sources,

including state agricultural networks and the Citizen Weather Observer Program, a public-private partnership with more than 7,000 stations in North America.

Daly also notes that nearly 90% of the precipitation data comes from citizen science programs, with one of them, the Community Collaborative Rain, Hail & Snow Network headquartered at Colorado State University, sending the PRISM group thousands of reports from around the nation daily.

While PRISM uses many data sources, Daly points out that one of the beauties of the state-of-the-art algorithm is that it allows for filling in gaps in information.

"We can interpolate where we have no weather stations; the PRISM modeling system accounts for how the Earth's features affect the spatial patterns of climate on the landscape," he said. "We have programmed in mountains, valleys, rain shadows, coastlines and water body sources, so we can make pretty accurate estimates on what average conditions are like across the lower 48. Our maps feature tens of millions of grid cells, half-mile by half-mile squares."

While the 30-year-normals are PRISM's trademark product, the group also has monthly climate maps of the same resolution back to 1895 and daily maps dating to 1981; those maps incorporate the same variables as the normals, whose information is ubiquitous in climate science.

"Anytime you see a detailed map showing percentage of average or deviation from average, most likely PRISM normals are underlying that calculation," Daly said.

Provided by Oregon State University