Researcher observes temperature variability across the world

September 30 2014

Michael Dillon, an assistant professor in UW's Department of Zoology and Physiology, is co-writer of a paper that measures temperature variability worldwide for a period of nearly the last 40 years. The paper was published in the online edition of *Nature Climate Change*.

If more of the world's climate becomes like that in tropical zones, it could potentially affect crops, insect fitness and malaria transmission, and even confuse migration patterns of birds and mammals worldwide.

A University of Wyoming professor is part of a research tandem that has found that the daily and nightly differences in temperatures worldwide are fast approaching yearly differences between summer and winter temperatures.

"We describe, for the first time, changes in temperature variability across the globe," says Michael Dillon, UW Department of Zoology and Physiology assistant professor.

"We've had a long discussion about changes in the mean temperature. It has been ongoing for more than 30 years," Dillon says. "It's very clear mean temperatures have shifted across the globe. It's less clear if the variation in temperature has changed."

For example, the variability in temperature could potentially mean bugs survive for longer periods in nontropical regions. The result could be increased crop damage (from pest insects) or spread of diseases, such as malaria carried by mosquitoes.

"If these bugs become more and more tolerant to these daily fluctuations in temperature, they can spend more of the year active and potentially have a bigger impact," Dillon says. "That's speculation."

Dillon is co-writer of a paper, titled "Recent Geographic Convergence in Diurnal and Annual Temperature Cycling Flattens Global Thermal Profiles," that was published in the Sept. 28 online edition of *Nature Climate Change*. The monthly journal is dedicated to publishing the most significant and cutting-edge research on the science of climate change, its impacts and wider implications for the economy, society and policy.

George Wang, a postdoctoral fellow at Germany's Max Planck Institute for Developmental Biology, was the paper's first writer.

One of the primary factors governing biological diversity across the globe is seasonality, Dillon says. Seasonality is the difference between the amount of variation organisms experience in the short term—days and weeks—versus the long term—more than one year.

For example, Dillon says the strong seasons in the temperate regions cause birds to migrate and deciduous trees to shed their leaves.

"Seasons are what differentiate life in the tropics and life outside of the tropics," Dillon says.

Crunching the numbers

Dillon and Wang first estimated global spacial variation in the mean temperature and in temperature cycling by analyzing more than 1 billion temperature measurements from 7,906 weather stations that sampled from the period of Jan. 1, 1926, through Dec. 31, 2009.

They then estimated global changes in the magnitudes of diurnal and annual temperature cycles from 1975-2013.

"We ask this mathematical technique to analyze a signal temperature over time," Dillon says. "From that signal, the technique pulls out the variability in daily temperatures and the variability in seasonal temperatures."

The range of diurnal temperature cycling (DTC)—meaning the change in temperature from the daytime high to nighttime low—was lowest at the poles, intermediate at the tropics and was relatively small close to large bodies of water and at lower elevations, according to the study. The range of annual temperature cycling (ATC)—meaning temperatures for any given location will go through a regular cycle on an annual basis—was lowest at the tropics and increased toward the poles.

"For these temperature zones that we historically think of as having lower daily variations relative to the annual variations in temperatures, what we found in these zones is that the ATC has not changed much in the last 30 to 40 years," Dillon explains. "But, the DTC has gone up

considerably. If the annual is constant and daily temperatures increase, areas outside the tropics will become more tropical. This idea of convergence could be a really important thing."

Dillon, who used the computer cluster in the UW Department of Geology and Geophysics to do some of the calculations, described the research as "very computationally intensive."

"It was several hundred years of computational time, and we had to do it again for the journal reviewers. He (Wang) used a computer cluster in Germany.

"What we have done is come up with a quantitative assay of how seasonal a place is when it comes to temperature," he says. "We find that the seasonality of the Earth is changing. This has continued, and even accelerated, even when increases in mean temperatures have paused in recent years."

More information: "Recent geographic convergence in diurnal and annual temperature cycling flattens global thermal profiles." George Wang & Michael E. Dillon. *Nature Climate Change* (2014) DOI: 10.1038/nclimate2378

Provided by University of Wyoming