# Study finds air temperature models poor at predicting stream temps

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(Phys.org) —Stream temperatures are expected to rise in the future as a result of climate change, but a new study has found that the correlation

between air temperature and stream temperature is surprisingly tenuous.

The findings cast doubt on many statistical models using air temperatures to predict future stream temperatures.

Lead author Ivan Arismendi, a stream ecologist at Oregon State University, examined historic stream temperature data over a period of one to four decades from 25 sites in the western United States to see if increases in air temperature during this period could have predicted – through the use of statistical models – the observed stream temperatures.

He discovered that many streams were cooler than the models predicted, while others were warmer. The difference in temperature between the models and actual measurements, however, was staggering – as much as 12 degrees Celsius different in some rivers.

Results of the study have recently been published in the journal *Environmental Research Letters*. The study involved scientists from Oregon State, the U.S. Forest Service and the U.S. Geological Survey, and was supported by all three organizations, as well as by the National Science Foundation.

"These air-stream temperature models originated as a tool for looking at short-term relationships," said Arismendi, a researcher in the OSU Department of Fisheries and Wildlife. "The problem is that people are starting to use them for long-term extrapolation. It is unreliable to apply uniform temperature impacts on a regional scale because there are so many micro-climate factors influencing streams on a local basis."

Sherri Johnson, a U.S. Forest Service research ecologist and co-author on the study, said the findings are important because decisions based on these models may not be accurate. Some states, for example, have projected a major loss of suitable habitat for trout and other species

because the models suggest increases in stream temperature commensurate with projected increases in air temperature.

"It just isn't that simple," Arismendi said. "Stream temperatures are influenced by riparian shading and in-stream habitat, like side channels. Dams can have an enormous influence, as can groundwater. It is a messy, complex challenge to project stream temperatures into the future."

What made this study work, the authors say, was evaluating more than two dozen sites that had historic stream temperature data, which can be hard to find. The development about a dozen years ago of data loggers that can be deployed in streams is contributing enormous amounts of new data, but accurate historic records of stream temperatures are sparse.

Researchers at USGS and at sites like the H.J. Andrews Experimental Forest in Oregon, part of the National Science Foundation's Long-Term Ecological Research program, have compiled stream data for up to 44 years, giving Arismendi and his colleagues enough historical data to conduct the comparative study.

In many of the 25 sites examined in the study, the researchers found that the difference between model-projected stream temperatures and actual stream temperatures was as great as the actual amount of warming projected – 3.0 degrees Celsius, or 5.5 degrees Fahrenheit. And in some cases, the projections were even farther off target.

"The models predictions were poor in summer and winter, and when there are extreme situations," Arismendi noted. "They were developed to look at Midwest streams and don't account for the complexity of western streams that are influenced by topography, extensive riparian areas and other factors."

Increases in air temperatures in the future are still likely to influence stream temperatures, but climate sensitivity of streams "is more complex than what is being realized by using air temperature-based models," said Mohammad Safeeq, an Oregon State University researcher and co-author on the study.

"The good news is that some of the draconian projections of future stream temperatures may be overstated," noted Safeeq, who is in OSU's College of Earth, Ocean, and Atmospheric Sciences. "On the other hand, some may actually be warmer than what air temperature-based models project."

Not all streams will be affected equally, Johnson said.

"The one constant is that a healthy watershed will be more resilient to climate change than one that isn't healthy – and that should continue to be the focus of restoration and management efforts," she noted.

Jason Dunham, an aquatic ecologist with the USGS and co-author on the study, said the study highlights the value of long-term stream temperature records in the Northwest and globally.

"Without a long-term commitment to collecting this kind of data, we won't have the ability to evaluate existing models as we did in this work," Dunham said. "Long-term datasets provide vital material for developing better methods for quantifying the effects of climate on our water resources."

Provided by Oregon State University

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