Large dams can affect local climates, says new study

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(PhysOrg.com) -- Large dams could have the potential to significantly alter local rainfall in some regions, according to a team of researchers including Roger Pielke Sr., of the Cooperative Institute for Research in Environmental Sciences (CIRES).

The study by researchers at Tennessee Tech University, Purdue University, CIRES and the University of Georgia, Pacific Northwest National Laboratory and Hellenic Center for Marine Research concluded that artificial reservoirs can modify precipitation patterns. The study—published in *Geophysical Research Letters*— marks the first time researchers have documented large dams, and their resultant changes in surrounding land use, having a clear, strong influence on the climate around artificial reservoirs in some regions; an influence markedly different from the climate around natural lakes and wetlands.

The results should spur consideration of more robust management of dams and set the stage for further research on the regions and climates to focus on, says Faisal Hossain, Tennessee Tech University civil engineering professor.

“This research shows you the smoking gun,” said Hossain. “Logically and physically we knew it was possible that a having a large body of water and spreading it around would change the local climate. Now, our results give us a better idea of which dams are most likely to gradually change local climate and what that means for managing those reservoirs as time passes.”

With Hossain and TTU doctoral student Ahmed Mohamed Degu leading the study, the research team looked at 30 years of climate data based on a technique known as reanalysis in the scientific community. Reanalysis aims to recreate the gold standard record of weather conditions everywhere in a domain by using as much information in hindsight as possible. The data used spanned from 1979-2009 and was collected 24/7 over North America.

Roger Pielke Sr. of CIRES says the work was a breakthrough study in scope and mission.

“This is a critically important, much needed study with multiple authors and institutions using diverse datasets in order to obtain information on how dams and the their surroundings affect the region’s climate rather than a local snapshot that may not be representative for larger areas,” said Pielke.

The study reports that large dams influence local climate most in the Mediterranean and semi-arid climates such in California and in the Southwestern United States.

So how does a large dam and its reservoir alter the climate? If the dam’s reservoir is large enough or if the water is spread around by uses such as extensive irrigation or recreational activities, then the expanded distribution of water creates an altered climate because it allows the water to evaporate more easily over a large area.

“Think of your typical backyard swimming pool,” said Hossain.

“If you pumped all the water out of your swimming pool and spread it onto your lawn, it wouldn’t take long for all that water to evaporate.”

A change in water available for evaporation can change humidity and

temperature and other aspects of the climate system around a reservoir. Under the right circumstances, all of these play an important role in changing rainfall.

“We now know we need to do better building and managing dams and reservoirs in those arid and Mediterranean regions where water is really scarce,” said Hossain.

Hossain says the report reflects a changing mindset in this area of research.

“We know a lot about how climate affects reservoirs, but what we didn’t know a lot about was what a reservoir could do to the local climate,” he said. “We just reversed our thinking by saying that a reservoir and the activities it supports are just as important a player for climate as the larger climate is for the reservoir. Basically, it’s a two-way street.”

Pielke says this framework, known as a vulnerability framework, is more inclusive and promotes more effective decisions.

“The change in mindset is to identify the vulnerabilities from a bottom-up resource-based perspective,” said Pielke.

Hossain agrees that this perspective changes the way civil engineers think in the classroom and on the job.

“Our profession generally has never looked at climate and what we do to it once we build large structures like dams, even cities, parks, ports, etc.,” said Hossain. “That work is missing at the interface of our profession.

“We now need to adapt, be more climate cognizant and broaden our horizons. Many of our dams in the U.S. are 50 years old and we need

answers for the future," he said.

"Now we have a better idea about how the local climate and rainfall may change than we did in the past, although more work is needed to pinpoint exact causes at each dam location," said Hossain. Nevertheless, we now can consider different scenarios and do a life cycle assessment before even building a dam.

"This is like saying we can now forecast what a dam may do to itself as it ages before even building it; then we build it according to a specification that the profession is prepared for," he concluded.

Provided by Tennessee Tech University