Every drop counts: New algorithm tracks Texas's daily reservoir evaporation rates

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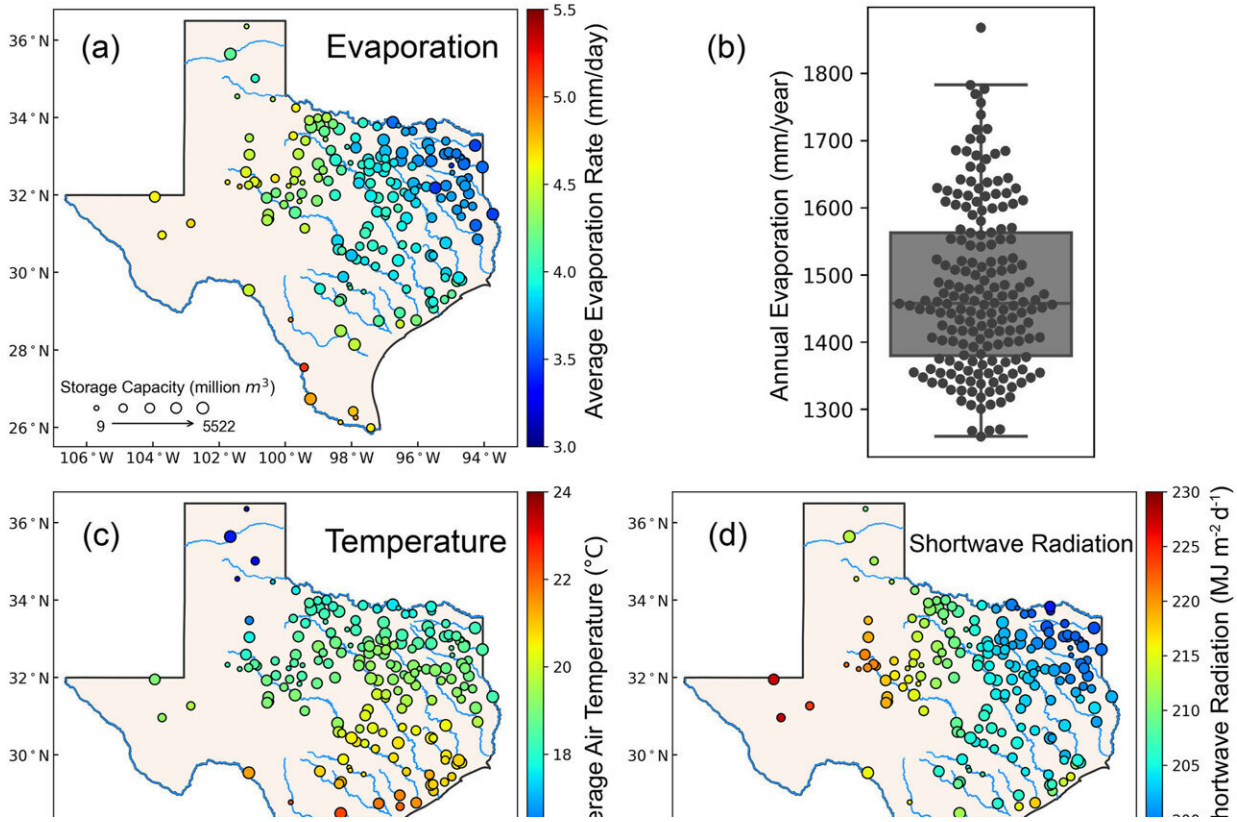

(a) Spatial distribution of the average daily evaporation rate from 1981 to 2021. (b) Boxplot of the average annual evaporation estimates for all 188 Texas reservoirs, (black dots represent the density of evaporation estimates). (c–f) Spatial distribution of average meteorological forcings (air temperature, shortwave radiation, VPD and wind speed at 2 m) from 1981 to 2021. The size of each circle represents the storage capacity (the storage capacity range of the 188 reservoirs is from 9 to 5522 million m^3). Credit: *Water Resources Research* (2024). DOI: 10.1029/2023WR036181

Summer can be an extra challenging time for Texas's 189 major water supply reservoirs. With temperatures consistently reaching 100 degrees or higher, reservoir evaporation rates see high increases.

Accurate evaporation rate estimates are crucial for water resource managers, as reservoirs play an essential role in our social and economic systems by supplying water for agricultural, municipal, and industrial consumption. Reservoirs are also critical for mitigating impacts from droughts and floods.

A recent study published in *Water Resources Research* highlights the efforts of Texas A&M University researchers Dr. Huilin Gao and Dr. Bingjie Zhao, with co-authors from multiple institutions, state, and federal agencies. The research team has developed a more accurate method for estimating daily evaporation rates.

"This method will enhance decision-making processes related to reservoir operations, water rights allocation, and long-term water planning in Texas and beyond," said Dr. Nelun Fernando, manager of Texas Water Development Board's (TWDB) water availability department.

Zhao, Gao, and their team developed a new computer algorithm to estimate daily reservoir evaporation that accounts for factors not considered by current methods.

"If you look at our daily evaporation algorithm, it uses regular meteorological data like wind, temperature, and relative humidity, so it's a lot easier to calculate for each reservoir," said Gao, a professor in the Zachry Department of Civil and Environmental Engineering.

According to the article, "Long-term and consistent reservoir evaporation information is typically reported on a monthly scale. Accurate daily evaporation information is lacking, but it is crucial for hydrological scientific research and regional water resource management."

The most common methods for estimating evaporation rely on data from Class A Evaporation Pans. These pans sit outside of the reservoir and estimate evaporation by measuring changes in the pan's water level. The pan evaporation data is then converted to reservoir evaporation data using an adjustment factor known as pan coefficients.

Since evaporation pans are typically located away from the reservoir, they do not account for the effects of wind, water depth, or air and water temperature differences across the reservoir. This can lead to inaccurate measurements, creating uncertainty for water resource managers.

"The lakes are much deeper than the evaporation pans, causing the water temperatures to be very different," said Zhao. "This means the evaporation rate predicted by the evaporation pan cannot represent the real lake accurately."

At this time, the daily evaporation algorithm has only been applied to Texas reservoirs. The results reveal a clear geographic distribution and strong seasonality of evaporation throughout Texas, with highest average losses occurring in July. Additionally, the data reveals a significant upward trend in evaporation rate, with an increase of about 1.1 inch per decade.

Gao and Zhao collaborated with Desert Research Institute (DRI) to develop an online portal that allows stakeholders to visualize and download data in near-real time.

Due to the success of the algorithm's estimation on Texas reservoirs, the research team is currently working on evaporation data for all major reservoirs in the western United States.

The paper was coauthored by researchers from DRI, TWDB, Lower Colorado River Authority (LCRA), U.S. Army Corps of Engineers (USACE) – Dallas-Fort Worth District, and U.S. Bureau of Reclamation.

More information: Bingjie Zhao et al, Developing a General Daily Lake Evaporation Model and Demonstrating Its Application in the State of Texas, *Water Resources Research* (2024). DOI: 10.1029/2023WR036181

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