New research shows using leaves' characteristics improves accuracy measuring past climates

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A study led by Baylor University geologists shows that a new method that uses different size and shape traits of leaves to reconstruct past climates over the last 120 million years is more accurate than other current methods.

The study appeared in the April issue of the journal New Phytologist and was funded by the National Science Foundation.

"Paleobotanists have long used models based on leaf size and shape to reconstruct ancient climates," said Dr. Daniel Peppe, assistant professor of geology at Baylor, College of Arts and Sciences, who is an expert in paleomagnetism, paleobotany and paleoclimatology. "However most of these models use just a single variable or variables that are not directly linked to climate, which obviously limits the models' predictive power. For that reason, they models often underestimate ancient temperatures."

Baylor geology researchers, along with 26 other co-authors from universities around the world, collected thousands of leaves from many different species of plants from 92 climatically-different and plant-diverse locations on every continent except Africa and Antarctica. Multiple linear regression models for mean annual temperature and mean annual precipitation were developed and then applied to nine well-studied fossil floras.

The results showed:

- Leaves in cold climates typically have larger, more numerous teeth, and are more dissected. Leaves in wet climates are larger and have fewer, smaller teeth.

- Leaf habit (deciduous vs. evergreen), local water availability and phylogenetic history all affect the relationships between climate and leaf size and shape.

- The researchers' multivariate mean annual temperature and mean annual precipitation models offer strong improvements in accuracy and precision over single variable approaches. For example, the mean annual temperature estimates for most of North American fossil floras were considerably warmer and wetter and in better agreement with independent paleoclimate evidence. This suggests that these new models offer the potential to provide climate estimates that will help scientists better understand ancient climates.

"Our study demonstrates that the inclusion of additional leaf traits that are functionally linked to climate improves paleoclimate reconstructions," Peppe said. "This will help us to better reconstruct past climates and ecosystems, which will allow us to study how ecosystems respond to climate change and variations in climate on local, regional and global scales."

Provided by Baylor University