Carbon and oxygen in tree rings can reveal past climate information

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The analysis of carbon and oxygen isotopes embedded in tree rings may shed new light on past climate events in the Mackenzie Delta region of northern Canada.

Scientists have long looked at the width of tree rings to estimate temperature levels of past years. Larger rings indicate more tree growth in a season, which translates into warmer summer temperatures. But the analysis of carbon and oxygen isotopes in tree rings can also provide accurate data on past climate events, say researchers working in northern Canada.

In a paper published in the most recent issue of the journal of *Arctic, Antarctic and Alpine Research,* Trevor Porter, a PhD student in Geography and Environmental Science at Carleton University, and three other authors compared temperature data collected in Inuvik, Northwest Territories (NT) since 1957 with their own analysis of isotopes found in white spruce trees in the Mackenzie Delta region of the NT. They found a strong correlation between the two data sets and temperatures.

"Isotope analysis is a good way to measure past climate change," says Porter about the results.

Isotope analysis is not a new way to measure past air temperatures. However, the method has not been widely used because lab costs have been prohibitive, especially when compared with the examination of tree ring width. Now, however, the cost of equipment has dropped substantially making it more affordable for researchers to use this method.

Porter's work was carried out on the northern edge of the boreal forest in the NT where trees are small but surprisingly old. "A 15 to 20 cm. tree could be a 300 to 400 year old tree," says Porter.

This slow rate of growth actually helps researchers because smaller trees stay standing longer. Trees that fall begin to decay making data analysis difficult or impossible.

"Once they get too large, it's difficult for trees to persist. They are susceptible to wind and ice storms. One of the reasons trees (in the North) persist so long is because they don't grow as much," says Porter.

Isotope analysis allows researchers to conduct their work using a smaller sample size than needed when trying to re-construct temperature records using tree ring width. Porter explains that the width of rings can vary considerably between trees even when they are growing in the same stand. This variation can complicate reconstructions of past climate.

A number of factors influence ring size, including the age of the tree and the location of the tree within the forest. Older trees tend to have smaller rings than younger trees. And trees within the same area might not all receive the same amount of light, nutrients or even water.

"Growth is controlled by many things . . . they (trees) can all end up just a little bit different," says Porter.

Isotope signals, on the other hand, are often very similar between trees. This means researchers can gather accurate data from three or four trees instead of the 20 they might need for tree ring width analysis.

"In ring widths there will be more variability between trees. There will be similar trends, but you have larger differences that you would find between the isotopes of different trees," says Porter.

Porter is hoping his work will lay the foundation for a model that can be used to investigate the long-term climate history of the Mackenzie Delta region. Although the temperature record for Inuvik only dates back to 1957, the dead and live tree ring record stretches to nearly 1000 years before present. That prospect excites the young researcher.

"The tree ring record goes back almost a thousand years in this area, but it's never been used for a temperature reconstruction. This is a really exciting time to work in climate research, especially for a young student," he says adding, "This is a hot topic."

Source: Arctic Institute of North America

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