

How using tree rings to look into the past can teach us about the climate changes we face in the future

November 2 2021, by Mary Gagen



Tree rings can tell us about periods of drought, warmth and heavy rainfall in the past. Credit: [Rbreidbrown/Wikimedia Commons](#), [CC BY-SA 4.0](#)

"The longer you can look back, the farther you can look forward," Winston Churchill [proclaimed](#) to the Royal College of Physicians in 1944, invoking a much older idea known as "[uniformitarianism](#)".

Coined by geologists James Hutton and Charles Lyell, this is the idea

that past processes (like erosion or [climate change](#)) that have [altered the Earth](#) over time remain similar, so we can analyze them to understand the consequences of future processes—such as how [climate](#) change might shape our planet in the years to come.

This principle of looking to the past to see the future still guides the science of [palaeclimatology](#), or the study of past climates.

For example, the [geological record](#) tells us there were [palm trees](#) in Antarctica many millions of years ago, when CO₂ was at 1,000 parts per million in our planet's atmosphere.

Looking back to [this period](#), when our planet was experiencing naturally high [CO₂ levels](#), helps us study what life on Earth might look like if our attempts to reach net zero emissions fail and greenhouse gas emission rates continue to rise.

When we want to look into the past, the greatest tools we have are called [proxy climate records](#). These are [natural archives](#) that [record](#) variations in climate, including ice cores, lake sediments, corals, cave stalagmites, peat and [tree trunks](#). These archives provide us with climate change data reaching further back than the few hundred years of information we can get from human instrumental weather records.

My research focuses on using data from trees to reconstruct historical climate conditions across the world, from [Europe](#) to [Malaysia](#) to [China](#) and [South Africa](#).

Rings

The most useful proxy we have for exploring the climate of the recent past is the [annual rings](#) that form in tree trunks. Using tree rings to reconstruct climate is known as [dendroclimatology](#).

In the UK's temperate climate, trees form a ring because they stop growing in the winter, forming a ring boundary at the start of each cold season. In other climates, the [dry season](#) forms the ring boundary. The width of rings, the density of wood and changes in wood chemistry [all record](#) what the weather was like in the year the ring formed. [Over time](#), trees build up a record of climate change in their trunks, forming a record in which each value can be tied to a calendar year.

Records

Trees' presence across most of the globe—and the ready availability of old tree samples in buildings, churches and boats, thanks to their construction from wood—are the reason tree rings are such a powerful data source. By piecing together living trees, dead wood and archaeological samples, our tree ring records stretch back [thousands of years](#).

One of the most important findings from global studies of tree rings has been that, over the [last 2,000 years](#), there has been no period before the industrial revolution in which the entire planet has warmed (or cooled) [at the same time](#). This is a unique feature of human-driven climate change in the industrial era: almost everywhere on the planet is warming.

We can look at periods of naturally anomalous climate during the last few thousand years to understand how our climate system changes when the planet warms. Exploring medieval records reveals that climate anomalies affect different places [in different ways](#).

The Medieval Climate Anomaly, for example, was named for the unusually warm temperatures experienced across Europe in the middle ages—although the eastern tropical Pacific region actually became cooler during this time.

Rain

Tree rings also help us understand past patterns of wet and dry climate phases. In areas where tree growth is sensitive to rainfall, including across [Europe](#), the [Asian monsoon region](#), [North America and Mexico](#), information from thousands of tree rings has been used to build up "atlases" of past changes in rainfall. These reconstructions reveal a stark picture of the relationship between the development of our societies and the stability of our climate.

In the dry areas of northern Mexico and the western US, archaeological wood provides a record of drought intensity going back 1200 years. This record reveals "[megadrought](#)" phases, where low rainfall led to narrow [tree rings](#).

There are close correlations between these narrowing rings and historical records showing the collapse of local [Native American](#) communities during a drought that tree ring records tell us lasted for decades.

UK populations have historically been more affected by wet summers than by dry ones, since they can lead to crop failure. Climate information in ancient British oaks shows when the UK and Europe experienced successive wet, cool summers.

One such event, around 1310, has become known as the [Dantean anomaly](#), an agricultural crisis that resulted in the loss of one-sixth of the population of Europe as wet summers led to crop failures and famine.

The [stories](#) of past climate that [trees](#) hold in their trunks give us a striking insight into how closely social and climate stability are intertwined. These stories of climate conditions long past raise questions about what kind of future we are making for ourselves.

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