

# CLIMATE CHANGE CONUNDRUM: warm and cold epochs, the IPCC and hockey sticks

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Recently, I had cause to ask, 'What happened to the Medieval Warm Period and the Little Ice Age?' My question related to the disparity between once widely accepted models of long-term climate change, in favour of new models dominating the narrative today. The same question could also be asked about a succession of Holocene epochs that have taken us through warm and cold; wet times and drought. The disparity between traditional and new models seems profound. I ask, why might this be of interest for environmental archaeologists and how might we contribute to the debate? With some specific examples, my emphasis is on how data from developer-funded excavations may contribute.

## Looking for warm and cold epochs

I was thinking about this because recently I wanted to know how warm, relatively, was the Medieval Warm Period compared to today? I tried to find a graph which shows the Holocene warm and cold epochs. Aiming for a quick answer to start with, I searched Google images, only to find the graph I was familiar with almost lost amongst pages of the new 'hockey stick' graph. Check your algorithms though, as a colleague and I have found our search results produced a difference balance of traditional and more recent models. It is the hockey stick that has become the poster child of anthropogenic global warming (AGW).

If we just take the last 1000 years, this is what I used to see:

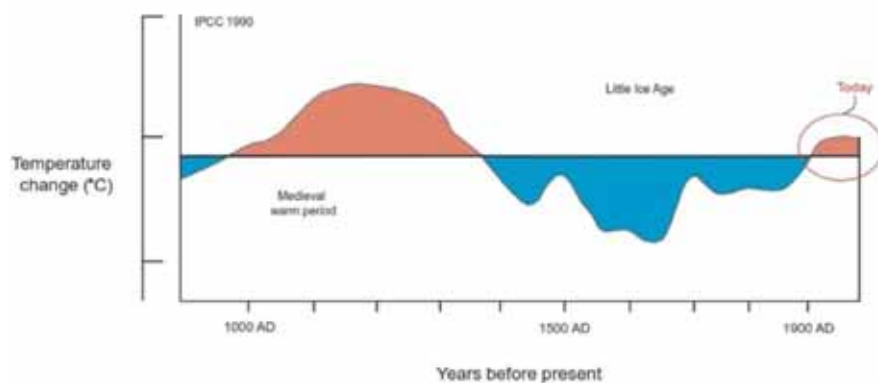


Fig 1. Climate data reported by the International Panel on Climate change 1990, Abbie Horton based on IPCC

The IPCC (UN-funded Intergovernmental Panel on Climate Change) accepted this temperature curve as recently as 1990. The data was compiled by many scientists from different institutions and countries.

## The hockey stick

The new 'hockey stick' model was introduced by Professor Michael Mann and team in 1998, and since 2021, the IPCC has endorsed an updated model.

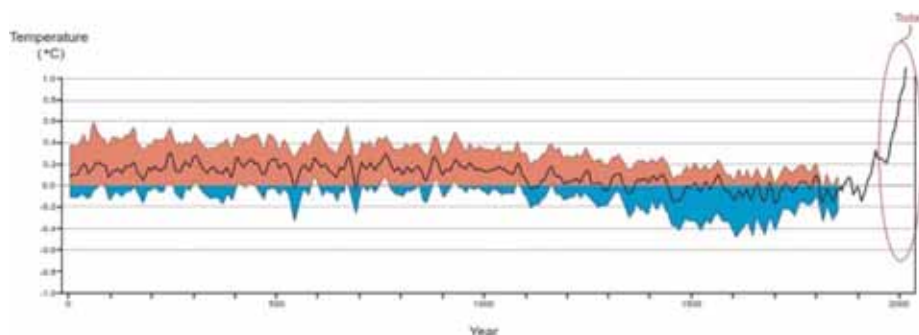


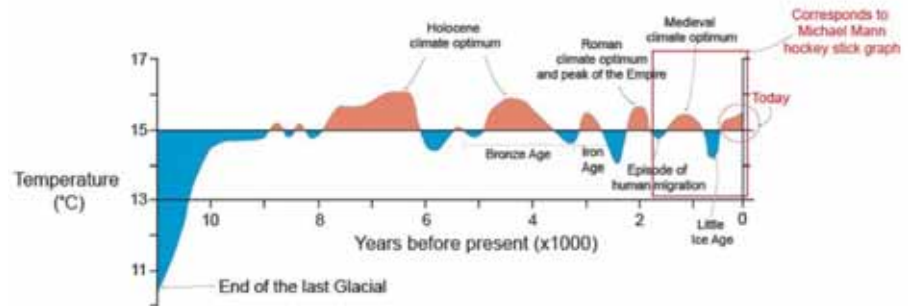
Fig 2. One recent version of a 'hockey stick' chart, Abbie Horton based on Elijah Wolfson for TIME magazine (Source IPCC, 2021); numbers are instrumental readings from 1850–2016; for prior years they are reconstructed using proxy records like tree rings, corals, and ice cores

Archaeologists are very familiar with warm and cold epochs. We often refer to the Atlantic Optimum, the Middle Bronze Age Optimum, the Late Iron Age climate plunge, the Roman Warm Period, the Medieval Warm Period, and the Little Ice Age, for instance, that relate to the northern hemisphere. Similar effects are also seen in the southern hemisphere.

**The handle**

But what happened to these epochs? Figure 1 shows the cold and warm epochs against which I've referenced environmental sequences for years. These changes are hard to see, though, in the Michael Mann graph, in what is often called the handle of the hockey stick (Fig 2). The change is radical. Figure 3 shows the entire Holocene as understood prior to Mann, and is based on decades of research resulting in our knowledge of climate change over millennia.

Fig 3. Average near-surface temperatures of the northern hemisphere during the last 11,000 years (Holocene), Abbie Horton based on David Archibald after Dansgaard et al. (1969) & Schönwiese (1995)



I see the disparity as fundamentally important, because if we're to cross-reference palaeoenvironmental sequences with a climate model, which one do we use – traditional or new? There are different versions of the hockey stick graph too. Conversely, if we can contribute to climate change models, which model(s) do we contribute to?

**The blade**

It's the 'blade' of the hockey stick that captures our attention because it implies rapid warming in the future. Naturally, curatorial archaeologists are also concerned, as it has significant implications for managing the archaeological resource. A leap in global temperature is implied since 1950 (Fig 2) and lies behind increasingly alarming predictions in the media that there will be rapid warming and sea-level rise that could affect archaeological deposits. There have been attempts in recent years to tease out how much warming is anthropogenic and how much natural in origin, and to amend the hockey stick graph

accordingly. Perhaps environmental archaeology can contribute towards this debate?

**The Earth archive**

We've cross-referenced a wide range of evidence to produce models for decades, and environmental archaeologists have contributed. We've used palaeobotany (my area of work), palaeozoology, tree-ring dating, radiocarbon dating, dated volcanic deposits in sediments, and recorded rising and falling sea and lake levels, for instance. Other scientists have travelled to inhospitable places, drilling into polar caps and the great glaciers, taking precise measurements of the composition of air trapped in ice bubbles. Work on Greenland and Vostock (Antarctica) ice sheets is well known.

**The history archive**

Along with medieval European chronicles recording exceptional weather are weather diaries. Historians also use evidence of harvest quality, size of the corn tithe, or prices for bread cereals – how much might this correlate with archaeobotanists' data on charred cereal crop assemblages? Inferences can seldom be made from a single source, so local and regional reports in large data banks (big data) are needed.

**How can environmental archaeologists help in the climate debate?**

**Regional or worldwide?**

Interpreting all types of evidence comes with methodological challenges, but developer-funded archaeologists are uncovering new data with every new development, flood alleviation or road scheme. Commercial archaeology lends itself to providing big data, which could help overcome uncertainties and refine climate models. Perhaps we can answer questions such as whether the warm and cold epochs are still valid, whether they are regional or worldwide in extent, and how we can contribute towards refining models in a way that makes best use of evidence that is widely recovered, in abundance?



Large oak roundwood charcoal from a late Roman marl quarry from The Hive, Worcester. Credit: Worcestershire Archive and Archaeology Service



Storm clouds over pasture.  
Credit: Brum



Slice through wood.  
Credit: Mateusz Atroszko

One question is the degree to which changes are regional or worldwide. Many articles now claim that the Medieval Warm Period (and other warm periods) is regional and only relates to the northern hemisphere, yet comparable warming for this period is seen in the Antarctic ice sheet (Lüning et al 2019), and elsewhere in the southern hemisphere such as in New Zealand (Cook et al 2002). Data for many parts of the world are, however, more limited than for the northern hemisphere. Whether the change is regional or not, data from British environmental archaeology work can help to refine perspectives on climate change in maritime Europe.

**New methods?**

There will always be new methods to apply to archaeological material. One includes stable isotope

analysis of charcoal, carbon-13 (Hall et al 2008), which has been used to reconstruct climate, although studies are few, and university based. As roundwood/branchwood charcoal is reasonably widely recovered from developer-funded excavations, this method could be more widely applied by incorporating this material into research projects. Even within the restrictions of commercial archaeology budgets, we may be able to produce small data sets, depending on the scale of the project. We have been able to do so for stable isotope analysis of human and animal bone, for other research purposes.

**Science is never settled, and as more evidence is retrieved from the ground year upon year, the complexities of climate change remain a challenge we can address.**

**References**

Cook, E R, Palmer, J G, D’Arrigo, R D, 2002 Evidence for a ‘Medieval Warm Period’ in a 1,100 year tree-ring reconstruction of past austral summer temperatures in New Zealand, *Geophysical Research Letters*, 29(14), 12-1–12-4

Hall, G, Woodburne, S, & Scholes, M, 2008 Stable carbon isotope ratios from archaeological charcoal as palaeoenvironmental indicators, *Chemical Geology*, 247, 384–400

Lüning, S, Galka, M, and Vahrenholt, F, 2019 The Medieval Climate Anomaly in Antarctica, *Palaeogeography, Paleoclimatology, Paleoecology*, 532. Also available at <https://www.sciencedirect.com/science/article/am/pii/S0031018219303190> Accessed 14 April 2023

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With over 25 years of experience, Liz is an environmental archaeologist, specialising in past environment, food, diet, agriculture, craft and industry. Liz works on commercially funded projects in the West Midlands.

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