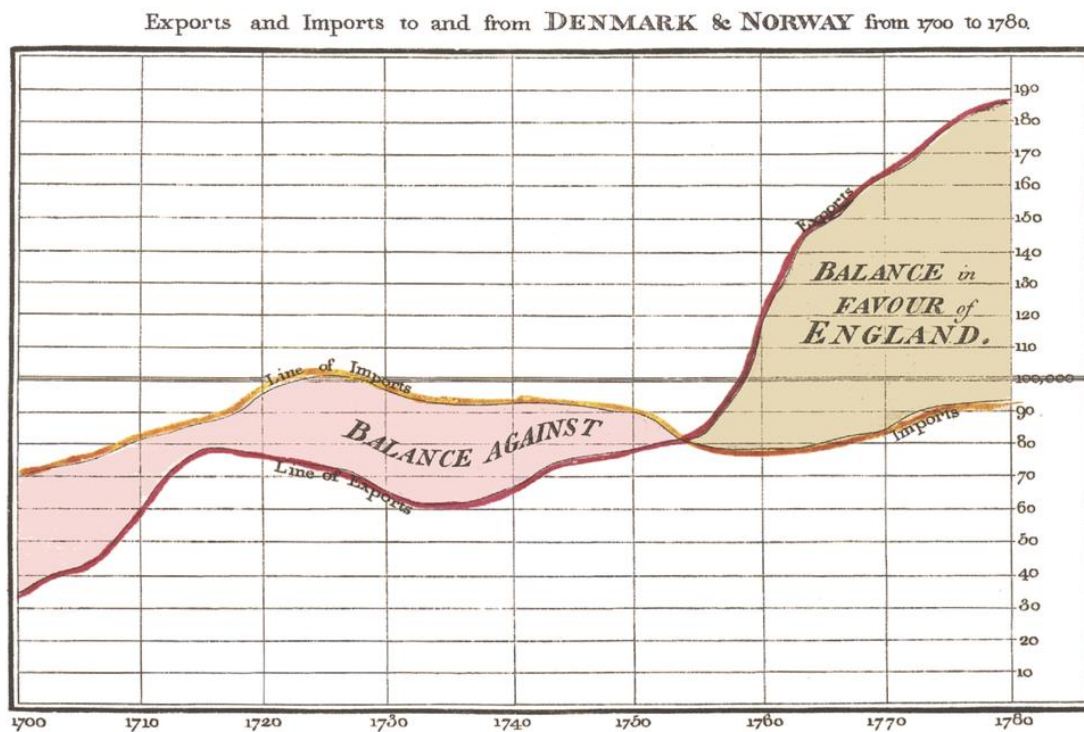
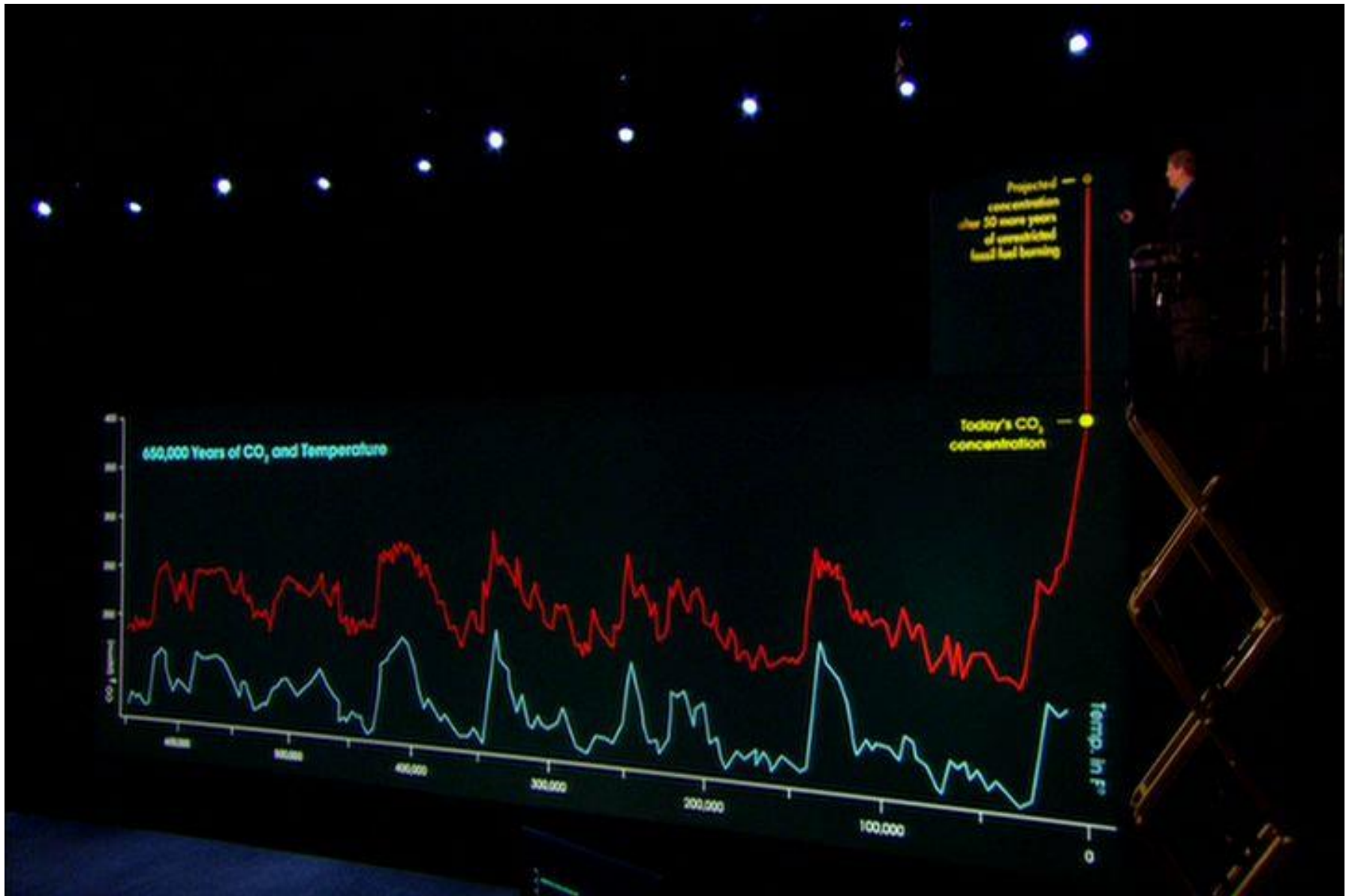


# 'Of Exactitude in Science': uncertainty and representation



*The Bottom line is divided into Years, the Right hand line into £10,000 each.*  
Published as the Act directs, 1<sup>st</sup> May 1786, by W<sup>o</sup> Flayfair. No. 100, Strand, London.



'You've heard of "off the charts"?: Al Gore elevated, from *An Inconvenient Truth* (dir. Davis Guggenheim, 2006)

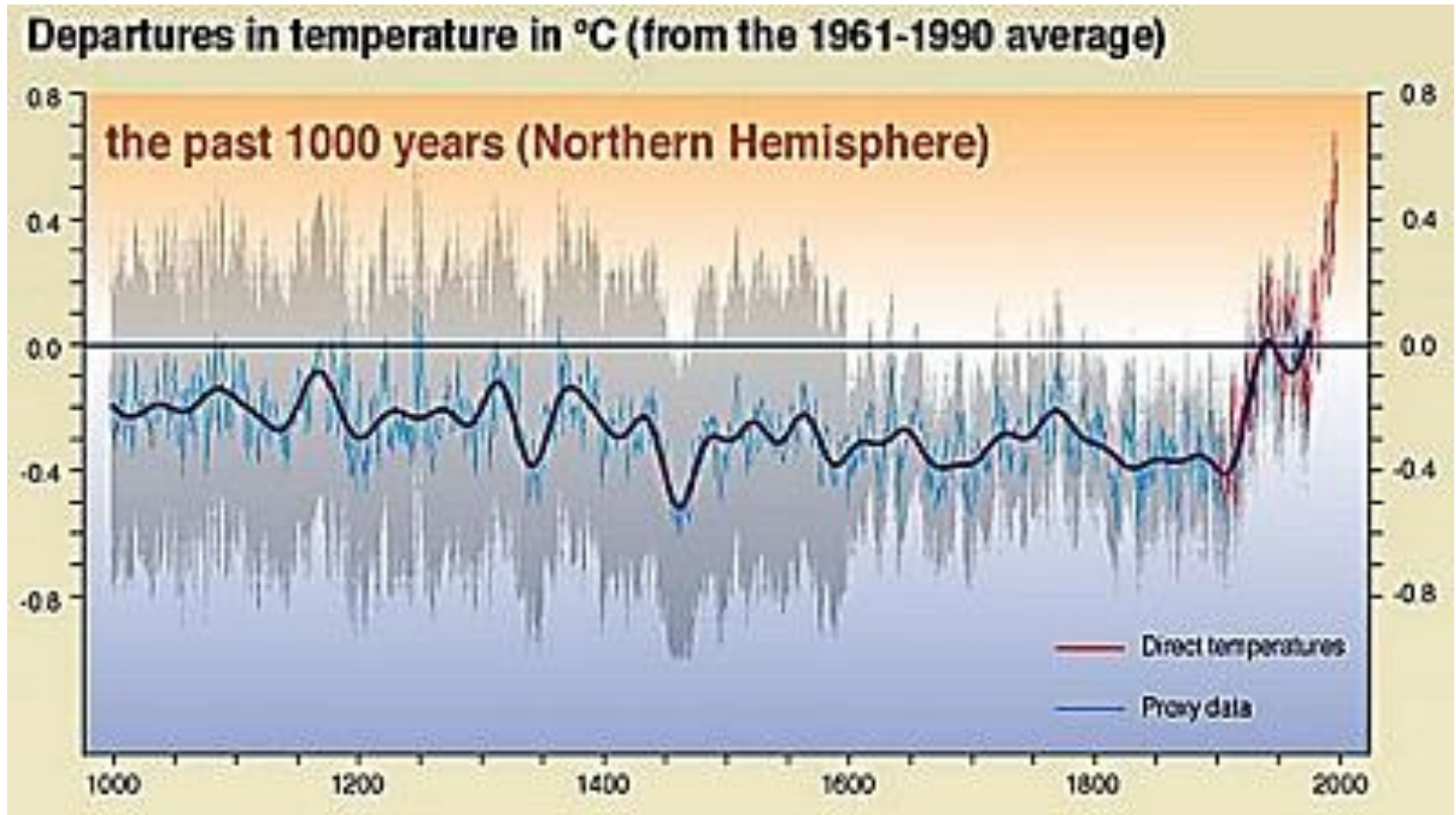


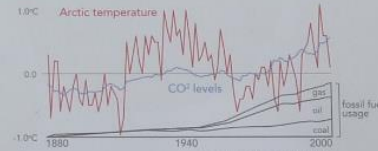
Figure from Michael Mann *et al*, 'Global-scale temperature patterns and climate forcing over the past six centuries', *Nature* 392 (1998), 779-87.

## THE GLOBAL WARMING SCEPTICS

We don't believe there is any credible evidence that mankind's activities are the cause of global warming - if that's even happening at all. There's only circumstantial evidence of a link between carbon dioxide levels and rising global temperatures.

### Rising CO<sub>2</sub> levels are not always linked with rising temperatures

Because of extreme weather, Arctic temperature is often a dramatic barometer of global climate. But the temperatures there match poorly with human CO<sub>2</sub> emissions.



## THE SCIENTIFIC CONSENSUS

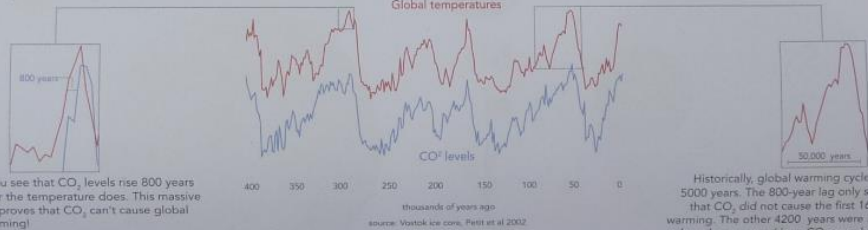
The earth's climate is rapidly warming. The cause is a thickening layer of carbon dioxide, enhanced by humanity's activities. It traps heat in the atmosphere, creating a "greenhouse effect" which heats the earth. A rise in global temperatures of 3 to 9 degrees will cause devastation.

### A single graph for a single small area is not enough evidence

You can't draw conclusions about the warming of the whole planet just by looking at a small area. It's like comparing apples and pears. It's impossible to tell what caused the warming of the Arctic in the 1930s. Or whether it's the same mechanism that's causing global warming today.

### In the past, CO<sub>2</sub> rises have occurred after temperature rises

Recognize this from *The Inconvenient Truth*? Al Gore famously showed that temperature and CO<sub>2</sub> are clearly linked back over 400,000 years. But if you zoom in...



### We don't claim CO<sub>2</sub> caused temperature rises in the past

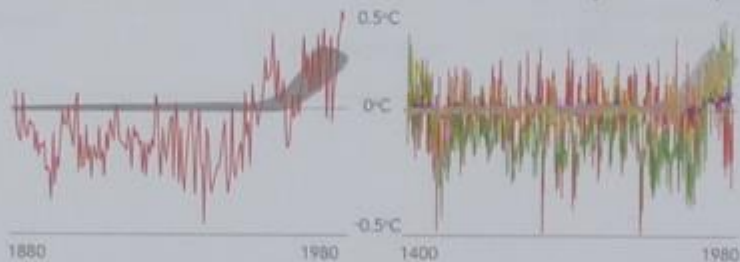
We say, because of its greenhouse effect, CO<sub>2</sub> makes natural temperature rises worse. Much worse in fact.

## The famous "hockey stick" temperature graph has been discredited

Made famous by Al Gore, the "hockey stick" graph shows that 20th-century temperatures are showing an alarming rise. But the hockey stick appears or disappears depending on the statistical methods employed. So unreliable has it become that the UN's International Panel on Climate Change (IPCC) dropped it from their 2007 report.

The Original "Hockey Stick"

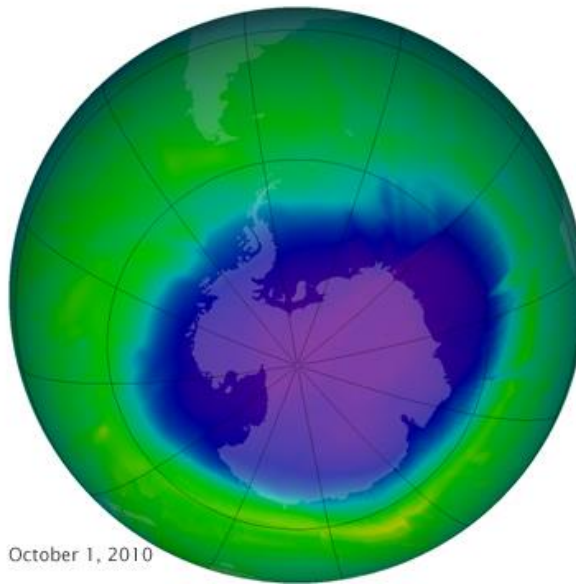
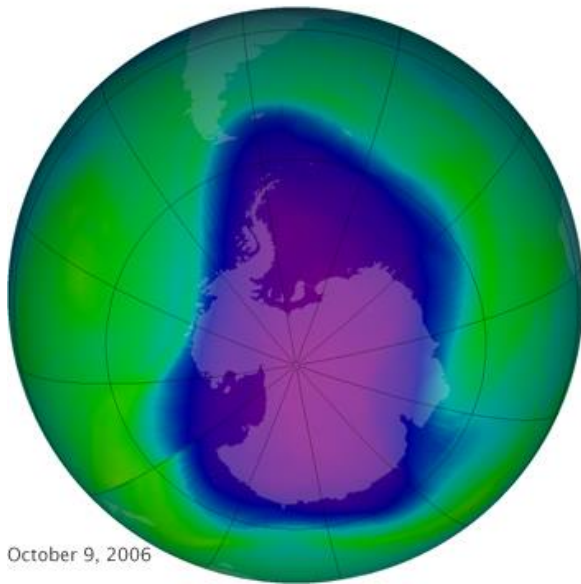
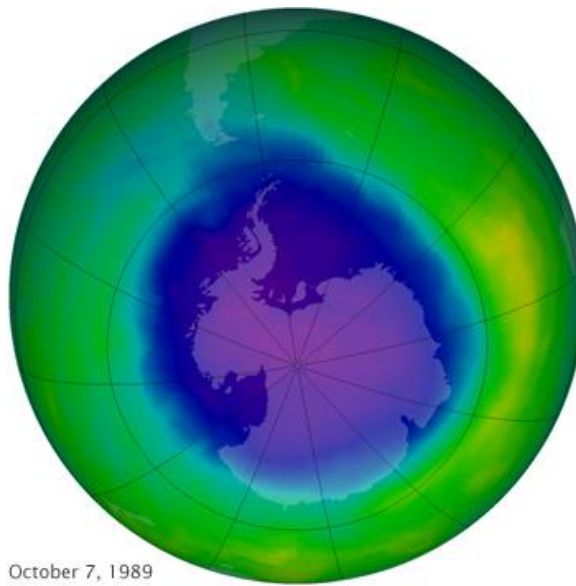
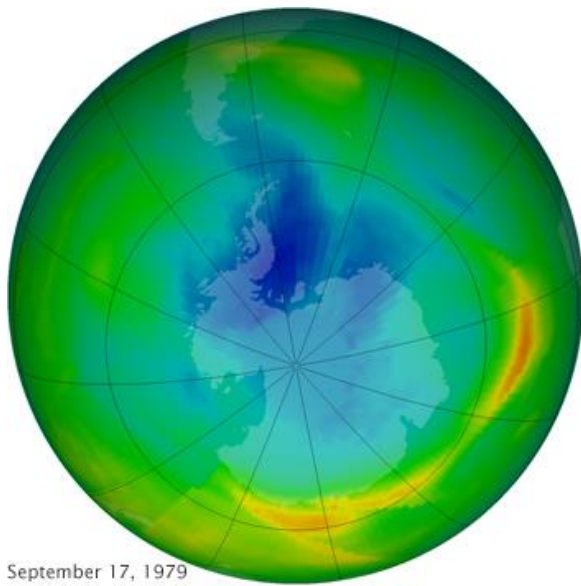
A Modern "Hockey Stick" Graph



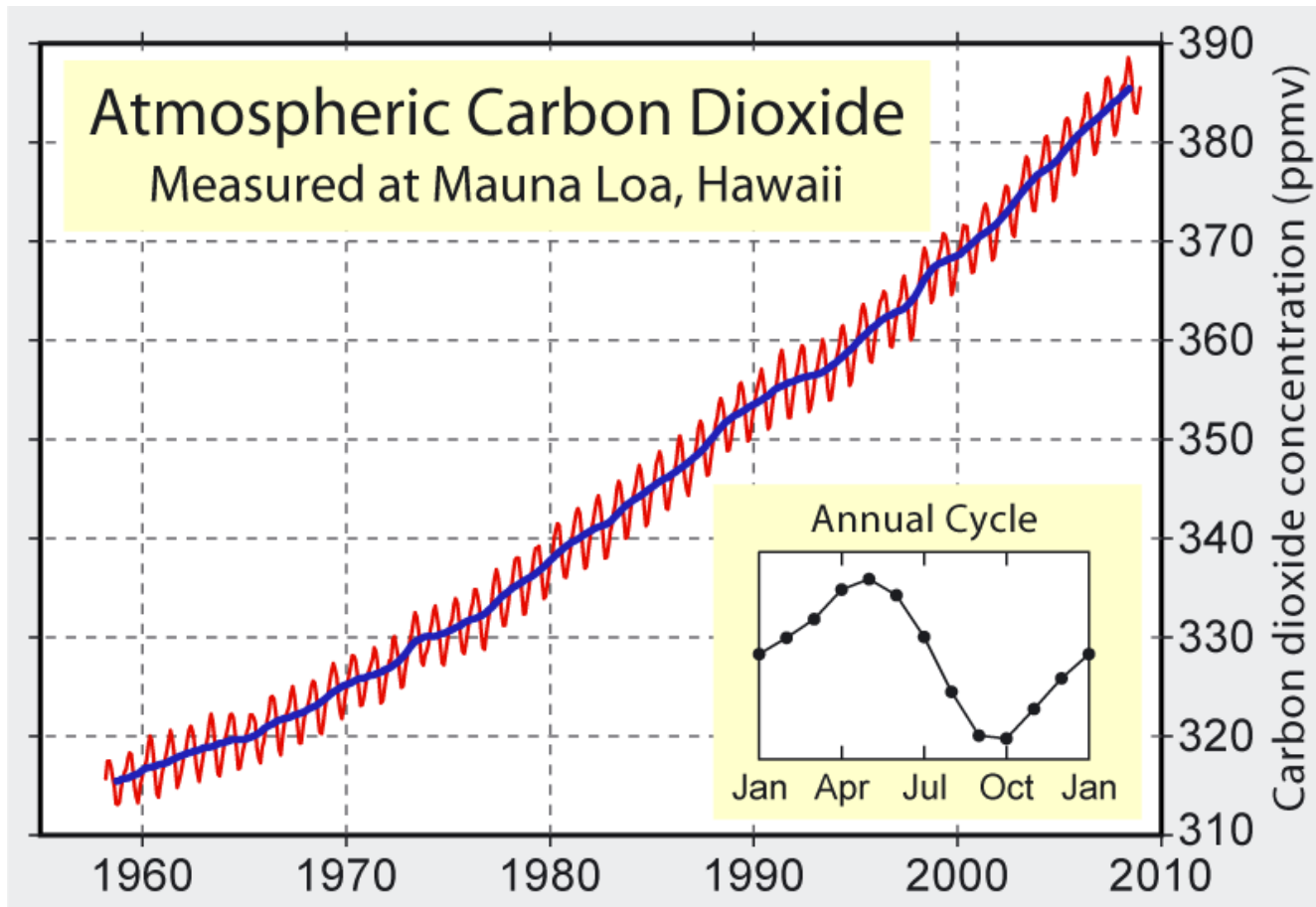
source: Author's composite Briffa, Anmann & Wahl, Mann 2002, Mann 1998

## Reworked, enhanced versions still show the "hockey stick" shape

The hockey stick is 8 years old. There are dozens of other newer, more detailed temperature reconstructions. Each one is different due to different methods and data. But they all show similar striking patterns: the 20th century is the warmest of the entire record. And that warming is most dramatic after 1920 (when industrial activity starting releasing large amounts of CO<sub>2</sub> into the atmosphere).



The 'ozone hole' over Antarctica, 1979-2010, as realized by the Goddard Space Flight Center's Scientific Visualization Studio. These images are perhaps the most effective scientific visualizations ever made.

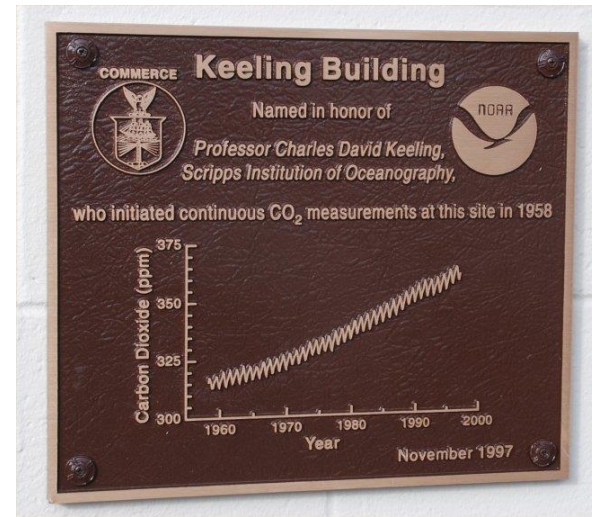


The 'Keeling Curve', 1958-

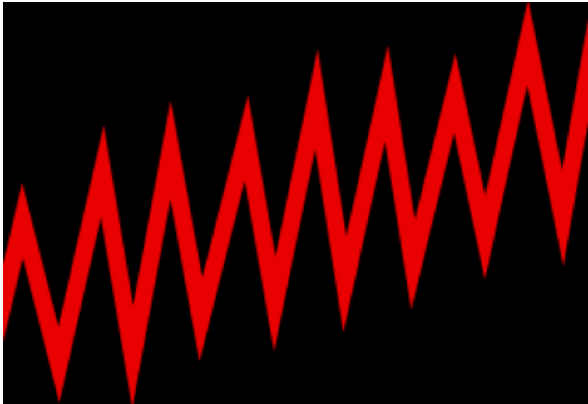
## The Keeling curve as a freestanding icon



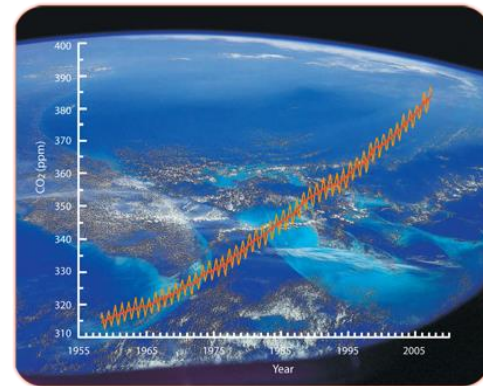
*Nature* 7171 (6 December 2007)



Plaque on the Keeling Building, Hawaii



From *An Inconvenient Truth* (2006)



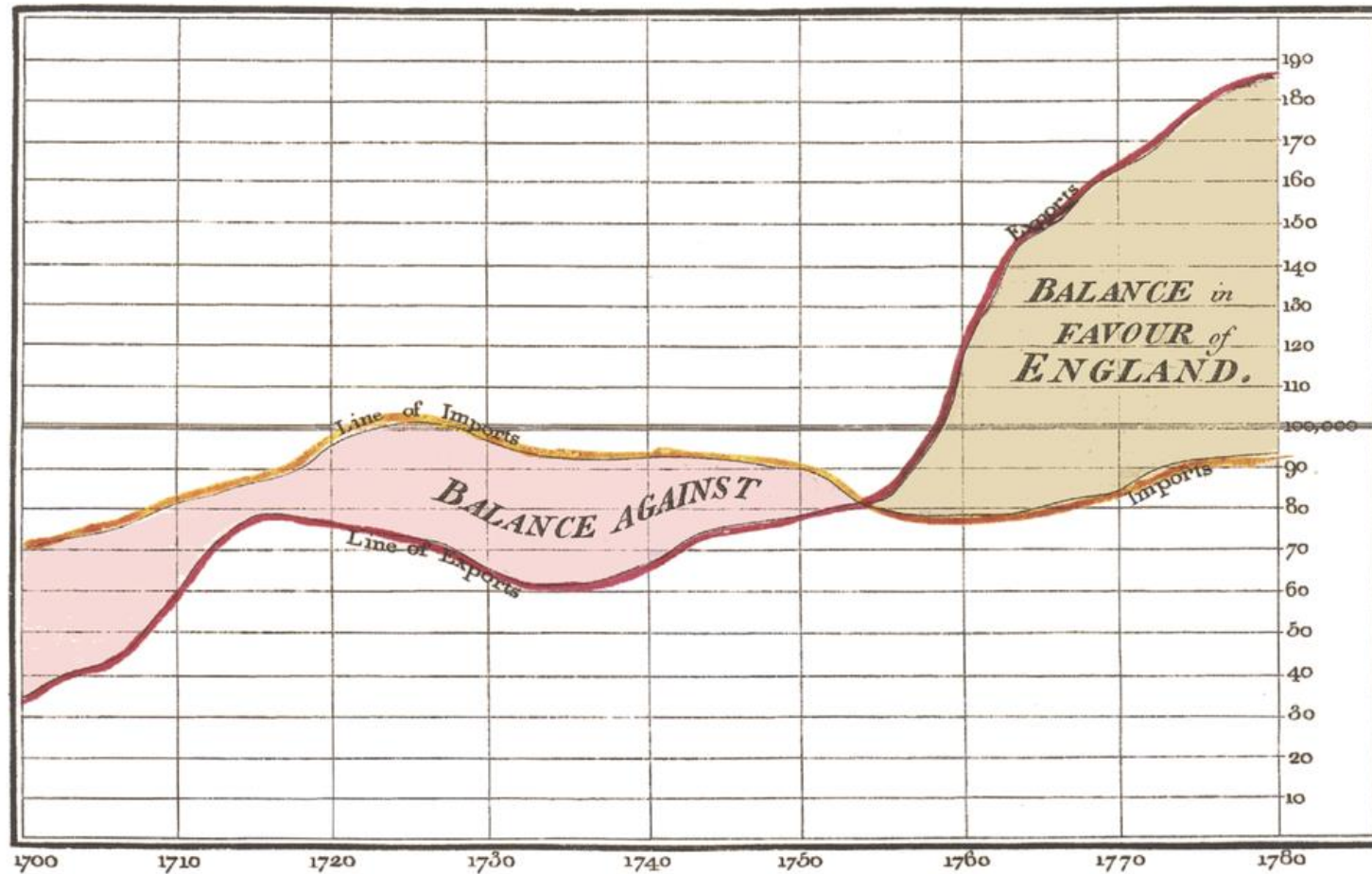
From the NOAA website



Beautiful Evidence: The Library of Edward Tufte, Christie's New York, 2 December 2010



Exports and Imports to and from DENMARK & NORWAY from 1700 to 1780.



*The Bottom line is divided into Years, the Right hand line into £10,000 each.*

*Published as the Act directs, 1<sup>st</sup> May 1786, by W<sup>m</sup> Playfair*

*Needle sculpt 352, Strand, London.*

William Playfair, 'Exports and Imports to and from Denmark & Norway from 1700 to 1780', from *The Commercial and Political Atlas Representing, by Means of Stained Copper-Plate Charts, the Progress of the Commerce, Revenues, Expenditure and Debts of England during the Whole of the Eighteenth Century* (London, 1786): the first publication to contain statistical charts.



‘The carbon footprint’, taken from the back of a 2-pint carton of British supermarket milk; is a visual literalization of a complex spatial metaphor that translates notional volumes of emitted carbon dioxide into an annotated visual icon. As a visual statement it is both clear and unclear at the same time (not helped, in this instance, by the mix of imperial and metric units, as well as the conflation of volume and weight measures: pints and grammes).