

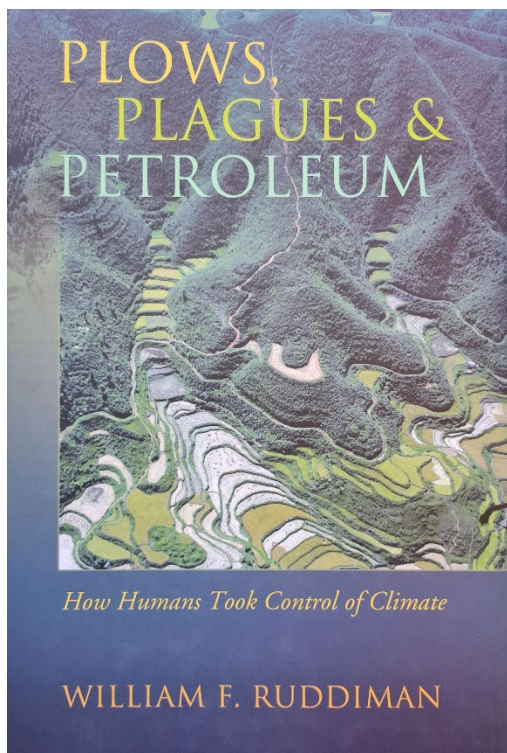
My 2005 'Climate Book of the Year'

Ruddiman, W.F. (2005) *Plows, Plagues and Petroleum: How Humans Took Control of Climate*. Princeton, NJ: Princeton University Press. 202pp.

This essay continues my series of monthly posts in which I select one 'climate' book to highlight and review from one of the 44 years of my professional career in climate research (starting with 1984, my first year of academic employment). The series will end in September 2027, the month in which I shall retire. [See here for more information](#) about the rationale for this series, and the criteria I have used in selecting my highlighted books.

This '2005 essay' can be [download as a pdf](#).

In July 2000, the Dutch atmospheric chemist Paul Crutzen coined a new term to depict a new epoch in Earth's history, one which recognised the magnitude, significance and irreversibility of human impacts on the planet's physical systems. He called this new epoch the



Anthropocene—'the age of the humans'. Within a few years this terminology was becoming widely adopted among large parts of the Earth System science community and, a few years later, within the academic world more broadly, including among social scientists and humanities scholars. By the second half of the 2010s the idea of the Anthropocene had also penetrated into some areas of wider culture and public awareness.

Yet the question of when this epoch started yielded different answers. Crutzen himself had implied a start date at the end of the eighteenth century—roughly the beginning of western industrialisation which began the recent rise in atmospheric carbon dioxide concentration. Others had different suggestions: the so-called 'Great Acceleration' of the post-war period of the twentieth century, or

around the time of 'first contact' between Europeans and native Americans in the sixteenth century.

American paleoclimate scientist [William 'Bill' Ruddiman](#) pursued a different idea. During the 1990s, Ruddiman had been curious about the rising concentration of atmospheric methane from around 5,000 years ago. Following his early retirement in 2001, he became curious too

about an unexpected rise in atmospheric carbon dioxide around 8,000 years ago. These increases in greenhouse gas concentrations belied everything Ruddiman knew about natural biogeochemical processes and he began to wonder whether these increases might have been linked to human activities.

No doubt prompted by Crutzen's initial intervention in 2000 for naming a new human-dominated epoch as 'the Anthropocene'—and Crutzen's subsequent formalisation of his proposal made in [Nature in January 2002](#)—Ruddiman put forward a different suggestion for when this epoch might be said to have started. He drew upon two lines of evidence: the anomalous trends in concentrations of methane and carbon dioxide in the mid-Holocene; and the extensive human modification of Eurasian landscapes that took place between 8,000 and 6,000 years ago. In 2003, he advanced the hypothesis that "the Anthropocene actually began thousands of years ago as a result of the discovery of agriculture and subsequent technological innovations in the practice of farming".¹ Two years later he developed more fully the 'early Anthropocene hypothesis' in 'Plows, Plagues and Petroleum: How Humans Took Control of Climate', the book I have selected as my **2005 Climate Book of the Year**.

Ruddiman was in his early 60s, an experienced palaeoclimatologist and emeritus professor at the University of Virginia in the United States. He had been trained as a marine geologist in the 1960s and had worked at the US Naval Oceanographic Office from 1969 to 1976. He moved to Columbia's Lamont–Doherty Earth Observatory in 1976 and then between 1991 and his early retirement in 2001 had been professor in Environmental Sciences at Virginia.² There are not many scientists who can claim to have a scientific hypothesis so closely identified with their own work that it becomes named after them. But this was the case with the early Anthropocene hypothesis which, after the publication of his book in 2005, became known as "the Ruddiman hypothesis".

The reason for such personalisation was not only that he clearly was the initiator of the original idea for an 'early Anthropocene'; it was also because this hypothesis challenged the prevailing orthodoxy of the mid-2000s. Ruddiman was criticising Crutzen's—and most other scientists'—view that the generation of greenhouse gases on a scale large enough to be detected on the Earth's climate started with the industrial revolution. Instead, he was arguing that early human agriculture emitted enough methane and carbon dioxide to offset what would otherwise have seen a fall in greenhouse gas concentrations and a significant cooling of Earth's climate.³ "I propose a very different view", wrote Ruddiman in 'Plows, Plagues and Petroleum':

¹ p.261: Ruddiman, W.F. (2003) The anthropogenic greenhouse era began thousands of years ago. *Climatic Change*. 61(3): 261-293.

² Ruddiman's credentials as a leading palaeoclimatologist had been consolidated through his earlier well-received textbook: 'Earth's Climate: Past and Future' (W H Freeman & Co., 2001).

³ Ruddiman, W.F. et al. (2005) A test of the overdue-glaciation hypothesis. *Quaternary Science Reviews*. 24: 1-10.

The start of the switch-over from [the] control of climate by nature to [its] control by humans occurred several thousand years ago and it happened as a result of seemingly 'pastoral' innovations linked to farming. Before we built cities, before we invented writing, and before we founded the major religions, we were already altering climate. [p.4]

Rather than being ushered in by the carbon-based capitalism of the industrial revolution, the Anthropocene epoch had in fact started at least 5,000 years earlier.

For these reasons, Ruddiman's hypothesis was controversial. But it also offers a very good illustration of how the process of science works. New evidence is brought forward which seems, *prima facie*, to challenge existing scientific theory and understanding; or, conversely, a new theory is proposed which leads to the search for new evidence that might either support or refute the theory. Either way, existing facts are scrutinised, scientific evidence is marshalled in new ways, and technologies are developed for acquiring new evidence. In its search for a more complete understanding of the physical world, scientific inquiry requires detractors and supporters of hypotheses to engage in robust argument, challenge, and exchange of views.

The creative, controversial and well-argued case made by Ruddiman meant that 'Plows, Plagues and Petroleum' generated a large number of reviews from many leading climate and paleoclimate scientists. Thus Jim Hansen at NASA's Goddard Institute for Space Studies noted that "Bill Ruddiman's provocative suggestion of early human influence on the atmosphere will draw fire"; Jonathan Overpeck at the University of Arizona that "[Ruddiman] caps a career at the cutting edge with a great new scientific debate"; Steve Schneider at the National Center for Atmospheric Research in the USA, "Progress in science requires innovation, and when dealing with science, Ruddiman is world-class"; Richard Alley at Penn State University, "[Ruddiman] presents a controversial hypothesis for early human influence on Earth"; and Ray Pierrehumbert at the University of Chicago, "[This] book is sure to inspire further thinking about the nature of anthropogenic climate change."

The book was also reviewed in the two top science journals in the world. Bob Charlson reviewing for *Nature* was positive about its basic premise, but recognised that it raised unanswered questions: "The debate continues among climatologists, but it would seem that Ruddiman must be at least partly correct Stone Age farmers added methane and carbon dioxide to the atmosphere, but how much and when?"⁴ James White reviewing for *Science*, recognised the controversial nature of 'the Ruddiman hypothesis', but recognised its value for science: "Ruddiman's ideas have not been greeted with open arms by the scientific community ... it is good to read of Ruddiman's faith in the scientific method and his willingness to let the process unfold as it should, even if that means he takes a few lumps along the way."⁵ The book's provocative hypothesis meant that it was also reviewed widely

⁴ p.166: Charlson, R.J. (2005) A Stone Age greenhouse. *Nature*. 438: 165.

⁵ p.472: White, J. (2006) Early and profound human impact? *Science*. 311: 472-473.

by historians and environmental historians, archaeologists and anthropologists, and in popular science magazines.

In the years after publication, Ruddiman continued to work on his own hypothesis, refining and defending his position. New editions of 'Plows, Plagues and Petroleum'—and with new visual covers—appeared in 2010 and then again in 2016. Ruddiman wrote a new Afterword for these later editions in which he responded to some of his critics, but also marshalled and interpreted new evidence as it had emerged from paleoclimate science. He continued publishing in the scientific literature into his 80s and in 2020, together with several long-established colleagues, published a major review of the recent scientific literature which "blend[ed] this new evidence into a revised version of the early Anthropocene hypothesis".⁶

Ruddiman's 'Plows, Plagues and Petroleum' and its early Anthropocene hypothesis remains a salutary demonstration of why science—even, or perhaps especially, a science such as climate science—needs to ensure that new ideas, new thinking and new hypothesis remain its essential lifeblood. Other scientists were forced to engage with Ruddiman's ideas, even if in the end it was to refute or at least to refine his basic claims. The book has been cited over 700 times and still attracts around 20 citations per year.

Ruddiman's work, and that of others inspired by him, was cited in all three subsequent IPCC reports—those of 2007, 2013 and 2021. In its 4th Assessment in 2007, Working Group 1 of the IPCC was quite dismissive of the mid-Holocene carbon dioxide anomaly which was central to Ruddiman's case. But six years later, the IPCC's Fifth Assessment Report concluded that there was a 50:50 chance that the methane increase after 5,000 BP was human-caused. The IPCC's most recent Assessment in 2021 recognises "there is some evidence for human influence on climate before 1750" [p.192], but downplays the significance of the 'early Anthropocene hypothesis'. At the very least, Ruddiman's argument makes it clear that, as [Wolfgang Berger writing for American Scientist](#) put it, "there is no 'natural' baseline of climate in the late Holocene from which to reckon the human impact of the past two centuries."

The Anthropocene continues to be debated and discussed across all academic disciplines and the idea is used in wider public discussion about humanity's relationship with the non-human world. Not least, these discussions revolve around when the Anthropocene started. For example in 2015, [Simon Lewis and Mark Maslin proposed](#) an Anthropocene start date of 1610, referencing a drop in atmospheric carbon dioxide levels, caused in their view by the expansion of vegetation in the Americas following European colonization. By moving the focus away from 18th century industrialisation, their proposal follows in the footsteps of the Ruddiman hypothesis.

⁶ Ruddiman, W.F., He, F., Vavrus, S.J. and Kutzbach, J.E. (2020) The early anthropogenic hypothesis: A review. *Quaternary Science Reviews*. 240: 106386.

Yet in March 2024, the scientific gatekeeper for naming geological ‘periodisations’—the Subcommission on Quaternary Stratigraphy (SQS) of the International Commission on Stratigraphy—ruled, [controversially](#), that it would *not* add ‘the Anthropocene’ to its designations of geological epochs, whatever the starting date. In their view, the clear stratigraphic evidence needed for such epoch naming was lacking.

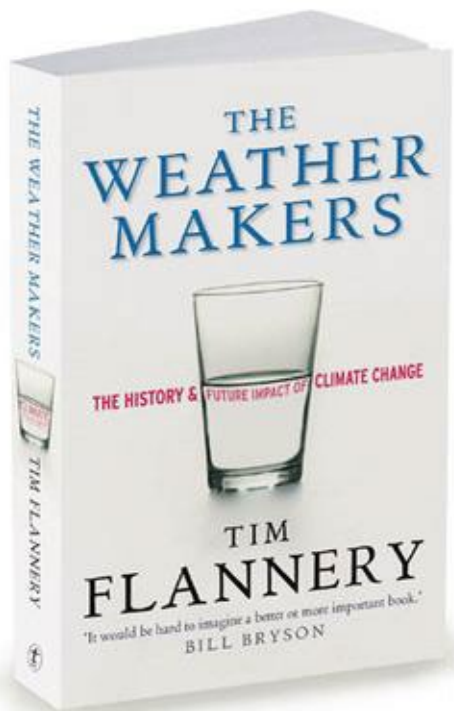
Despite the SQS ruling, the Anthropocene lives on as a ‘cultural idea’, if not as a formal geological epoch. Ruddiman’s ideas presented in his 2005 book made an important contribution to the thinking behind the idea of human influence on the Earth’s climate. Even if his early Anthropocene hypothesis cannot be fully validated, it forms an important part of the story of understanding how, and to what extent, humans have influenced climate.

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Other significant books published in 2005

Flannery, T. (2005) *The Weather Makers: The History and Future Impact of Climate Change*. Australia: The Text Publishing Company/London: Allen Lane. 368pp.

The middle years of the first decade of the new millennium witnessed a surge—certainly in the western world—in popular communications about the realities and challenges of climate change. The climate science and arts project, [Cape Farewell](#), was initiated in 2001 by David



Buckland, Roland Emmerich's Hollywood disaster movie '[The Day After Tomorrow](#)' appeared in 2004, and Al Gore was on the road with his 'Inconvenient Truth' powerpoint slides. And a new cohort of popular science writers were turning their attention to climate change, among them the Australian scientist, explorer, conservationist, activist and author [Tim Flannery](#).

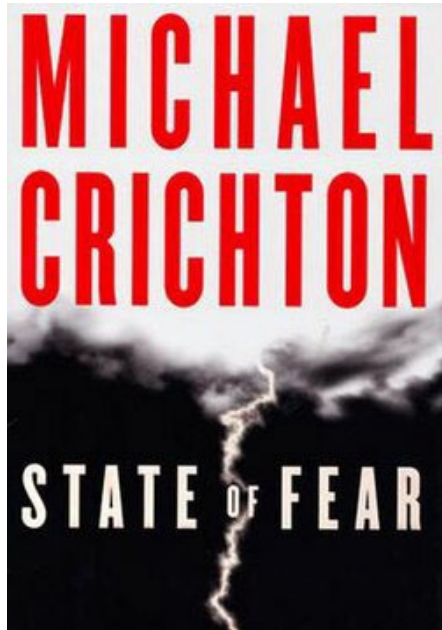
Flannery was already a well known public science writer in Australia, following his 1994 book, '[The Future Eaters](#)', later adapted for television, about the natural history of Australasia. Now, aged 49, he published 'The Weather Makers: The History and Future Impact of Climate Change'. In the book's Introduction we learn that Flannery trained as a palaeontologist and although attuned to changing environmental conditions through his extensive

fieldwork in Papua New Guinea, he had "resisted the impulse to devote research time to climate change" [p.4], before his interest was triggered by the IPCC's Third Assessment Report in 2001, an interest which, by 2004, had "turned to anxiety" [p.6].

'The Weather Makers' was the result of this new-found anxiety and in 36 short essays Flannery surveys for a popular audience the historical evidence for climate change, the signs that humans are changing the climate, the consequences of this global warming—including his fear of mass extinctions—and finally a run-through of some proposed solutions, individual actions as well as international and governmental ones. The book immediately found a receptive audience in Australia and beyond. New international editions were published in 2006 and 2007 and it was translated into twenty languages. 'The Weather Makers' made the *New York Times* Best Seller list in 2006 and won a slew of national and international literary awards, and in 2007 Flannery was named '[Australian of Year](#)'. The book is significant for its engaging style, its wide geographical readership, and its contribution during the 2000s to the popularisation of climate change.

Crichton, M. (2005) *State of Fear*. London: Harper Collins. 624pp.

[John] Michael Crichton (1942-2008) was an extraordinarily successful American author, screenwriter and filmmaker. His books, notably [‘Jurassic Park’](#) (1990)—which led to the Jurassic film franchise—have sold over 200 million copies worldwide, and at least ten of



these books have been adapted into films. Crichton’s novels were usually science fiction or techno-thrillers, and often featured technology. In 2005 he ventured into climate fiction by writing ‘State of Fear’. The book was extraordinarily successful, particularly in the United States. It had an initial print run of 1.5 million copies and in January 2005 reached the #1 bestseller position at Amazon and #2 on the *New York Times* Best Seller list. Its success led to Crichton receiving an invitation for a private meeting with then President George W Bush and also to give testimony at a 2006 US Senate hearing on climate change.

The novel is a thriller about ecoterrorism, the fictional extremist environmental organization, ELF, engaging in violent subterfuge in order to raise concern among an apathetic public about the problem of climate change. The book was hugely successful, partly because of Crichton’s undoubted skill as a storyteller and partly because of the success of his previous books such as ‘Jurassic Park’. Curiously for a work of fiction, Crichton included in the book many graphs and footnotes, two appendices, and a 20-page bibliography, giving the fictional story the appearance of scientific authority. In doing so, Crichton—who was critical of the existing scientific consensus on climate change—popularized some of the criticisms of climate science made by climate sceptics and contrarians, especially American ones. This undoubtedly contributed to its popularity in the USA.

Literary critic George Handley has argued that Crichton “may very well be the Rachel Carson of climate scepticism” and the British scientific entrepreneur and inventor of Gaia, James Lovelock, considered Crichton “such a good storyteller” that the public are “more likely to be influenced by writers like [him] than they are by scientists”.⁷ These are some of the reasons why ‘State of Fear’ should be included in any historiography of climate change. Before the sub-genre of ‘Cli-Fi’ had been formally named as such, Crichton—along with more ecological attuned writers such as [Maggie Gee](#)—was already creating it.

⁷ p.156 in: Handley, G.B. (2019) Climate scepticism and Christian conservatism in the United States. Chapter 4 in: *Climate Change Scepticism: A Transnational Ecocritical Analysis*. (eds.) Garrard, G. et al. London: Bloomsbury Academic; p.62 in: Lovelock, J.E. (2006) *The Revenge of Gaia*. London: Penguin.