A 'best of' climate compilation

The Warming Papers

Edited by David Archer and Ray Pierrehumbert

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The book 'The Warming Papers', assembled by David Archer and Ray Pierrehumbert, is surprisingly original, given that it does not contain much original material. The objective of Archer and Pierrehumbert was simple: to assemble in one book some of the key scientific papers that have been published over the past 150 years or so on the science of climate change.

Compiling the seminal papers in climate science seems like a straightforward task, and the first question that might come to mind is whether the book is worth reading, given that there isn't anything new in it. I would argue that it is, and will use a musical analogy to try to demonstrate that there are, at least, two types of potential readers for such a book.

Were a brand new 'best of' Beatles album to be released, there would be at least two potential kinds of buyer. There would be the die-hard Beatles fan, who already has all of the tracks but needs the compilation as well, for the sake of completeness and, perhaps, because it is convenient to have them all on a single album. Another potential buyer would be the newcomer to the Beatles, who might see this is a good way to get to grips with Sergeant Pepper, Rocky Racoon and the rest.

Likewise, Archer and Pierrehumbert's book should attract two types of audience: the old expert, who already knows about these papers; and the non-expert, perhaps the student new to climate science, who wants to get an overview of the climate change issue by reading a series of authoritative peer-reviewed scientific papers. Most scientists would agree that this is a much more rigorous approach than reading a couple of magazine articles, blogs and books, or even watching a movie — all of which are tailored for a larger audience.

The authors — they humbly call themselves editors, despite writing insightful introductions to the subject matter — compiled thirty-two papers. The book is organised into two parts — one on climate physics and the other on the carbon cycle. Each part is divided into sections comprised of a couple of papers reproduced exactly as they were published, including original typos. Each paper is preceded by a brief introduction by Archer and Pierrehumbert that sheds some light on the scientific understanding at the time, and explains why the paper was indeed critical.

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First, they go back to the pioneering papers of Fourier, Tyndall and Arrhenius, who were the first to suggest that gases in the Earth's atmosphere trap heat. By introducing the concept of the greenhouse effect, these papers laid the foundation for the field of climate science. Next, there are papers from the 1960s showing that numerical models can be used to assess the influence of increased atmospheric carbon dioxide concentrations on climate, latitudinal energy gradients and ice-albedo feedbacks. This is followed by the very first attempts to represent the complexity of the climate system with numerical global tri-dimensional climate models, with landmark papers from Hansen *et al.*, Manabe and Wetherald. The physical climate section concludes with some more recent papers documenting aerosol-induced cooling, changes in ocean heat and ice sheet extent, and observed changes in atmospheric temperature.

The carbon cycle part of the book takes us back to the 1950s, with papers that set the stage for ocean carbon cycle modelling. Then come Keeling's papers from the 60s and 70s, which document both the seasonal cycle of atmospheric carbon dioxide concentrations and its attribution to the breathing of the land biosphere, and the rise in carbon dioxide concentrations due to anthropogenic emissions. Later papers that paved the way to global carbon cycle science follow, such as the seminal 'missing sink' paper from Tans *et al.*, which shows that terrestrial ecosystems play a role in absorbing excess carbon dioxide. The carbon cycle section concludes with papers describing the long tail of the carbon cycle, the ocean acidification story and fluctuations in atmospheric carbon dioxide concentrations on glacial–interglacial timescales.

I found the short introductions by Archer and Pierrehumbert very interesting. They offer a reminder of (or in some cases, an introduction to) what the papers are about, what the controversy was at the time of original publication, and why they emerged at just the right moment. These introductions give you the feeling that you know a bit of the inside story, including misconceptions about atmospheric warming and over-optimistic assumptions about the ability of the ocean to absorb excess carbon dioxide. This is particularly true for the introductions to the early papers.

As for the Beatles Greatest Hits, the expert might feel that the selection of papers is subjective — and, of course, it is. I am one hundred per cent behind Archer and Pierrehumbert on their selection of papers from the old days; it is easy to be objective with the benefit of several decades' worth of hindsight. They are landmarks in climate change science, were real breakthroughs at the time, and have been cited hundreds (if not thousands) of times since. Every climate scientist should have read them.

However, when it comes to their choice of more recent papers published over the past ten years or so, their reasoning for selection is not so clear to me. They are all important papers in their respective fields, and most of them are already highly cited. But are they landmark warming papers, as suggested by Archer and Pierrehumbert? It is not clear whether climate scientists will remember them in thirty years' time, in the way that we all remember the papers by Manabe and others. Only the filter of time will tell.

Meanwhile, I still warmly recommend this book. It is always a great pleasure to (re)discover these warming papers. Enjoy listening — sorry, I mean reading. ❐

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