

BOOK REVIEWS

Climate Change: A Multidisciplinary Approach, Second Edition

 William James Burroughs
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William Burroughs, who died in November 2007, was a wonderfully clear and evocative writer. Chapter 3 of his last work, *Climate Change: A Multidisciplinary Approach*, begins with the loveliest four-paragraph description of the general circulation of the Earth's atmosphere I have ever encountered. His writing also shines in his descriptions of the climate record of the past few thousand years, and in his introduction to the measurement of climate change. Unfortunately, the book is marred by inconsistencies in its treatment of climate dynamics, as well as by a number of idiosyncratic choices of emphasis that detract from the book's quality as a general introduction to the science of climate change.

The book takes on the ambitious task of surveying all of climate science—from the snowball Earth hypothesis to the hockey stick (which refers to the shape of the graph of temperature versus time over the past 2000 years presented in the Intergovernmental Panel on Climate Change's (IPCC) Third Assessment Report)—in a single volume for a general undergraduate audience, using very little mathematics. It is weakest in chapters 2 and 3, which discuss the Earth's energy balance and the elements of the climate system, respectively. There are some outright errors, including a figure and caption that state that “the orbit of the Earth is an ellipse but the sun is not one of the focal points,” and a misleading and confusing discussion of stationary waves in the 500-hectopascal geopotential field. Despite much discussion of blocking phenomena (in which a high-pressure area becomes stationary at midlatitudes, resulting in a persistent weather pattern whose end is difficult to predict), the book never clearly explains the reasons for transitions of the pattern of winds from flow along latitude circles to wavy (or blocked) flow, and baroclinic

instability of the smooth flow—which leads to wavy flow—is never mentioned.

There is a long and thorough discussion of various modes of air-sea interaction, including the El Niño–Southern Oscillation, the Pacific Decadal Oscillation, and the North Atlantic Oscillation, but there is surprisingly little discussion of the monsoon and its interannual variations. The discussion of the thermohaline circulation includes inconsistencies: The final paragraph of chapter 3 suggests that the Gulf Stream could be “switched off” as a result of instabilities in the thermohaline circulation, while an earlier paragraph correctly dismisses this possibility as a misunderstanding of the relationship between the wind-driven and thermohaline circulations.

Burroughs was fascinated with possibilities of nonlinear jumps in weather and climate, and he discusses such phenomena on many spatial and temporal scales including meteorite impacts, massive basalt flows, flips in the thermohaline circulation, and blocking events in the atmosphere. The book's introduction presents the climate system as a boiling chaos, where multiple causes and hair-trigger dynamics make any response to a given forcing possible. However, the introduction never makes the case beyond guilt by association that such behaviors are important obstacles to the forecasting of climate change on the timescale of a century. The author never explicitly states that climate is chaotic on this timescale, but since the book sets out with the practical goal of providing “a balanced view to help the reader to give the right weight to the impact of climate change on their chosen disciplines,” one gets the sense that the long discussion of chaotic aspects of the system is intended as a warning that prediction of climate change over the coming century may not be possible at all.

It appears from the book's somewhat sketchy final chapter that the author was in the process of being convinced, by sci-

ence summarized in the IPCC Fourth Assessment Report, that “there is a clear separation between the simulations with anthropogenic forcing and the simulations without,” and more generally, that climate change on the scale of a century might be in a regime where predictable forcing rather than internally generated fluctuations dominates variability.

Considering Burroughs's fondness for odd bits of climate speculation (he devotes pages to describing the possible role of tidal interactions in forcing long-term climate variability, and to the idea that climate changes might force volcanic activity in such a way as to feed back on climate change), there are a number of unfortunate omissions. The book makes no mention of William Ruddiman's early anthropogenic hypothesis. The only mention of the problem of ocean acidification is in a table of climate change impacts that seems to imply that acidification would be a problem only if climate sensitivity turned out to be large. The potential for rapid melt in Greenland is only briefly mentioned.

Finally, and perhaps most surprisingly, given Burroughs's inclination toward a measured approach to carbon emission limitations, there is no discussion of any geoengineering options. I would have been particularly interested to read how Burroughs would have viewed the prospect of the deliberate addition of sulfur dioxide to the stratosphere to counter warming by carbon dioxide. On the basis of the rest of the book, I cannot predict whether he would have approved a deliberate addition as an evolutionary response that avoids looking too far into the future, or whether he would have considered it a hubristic overreach based on an overconfident assessment of our ability to predict the climate implications of our actions.

Because of the book's idiosyncratic choice of emphasis, especially in its omission of atmospheric dynamics, I would not want to make *Climate Change* the only textbook for a course on the topic. However, its strong treatment of a wide variety of topics in climate history and climate dynamics, the clear writing, and the strongly (though inconsistently) expressed authorial viewpoint could make the book a very useful supplement to a more quantitative climate dynamics text.

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