BOOK REVIEW

Climate Change and Climate Modeling

J. David Neelin
Cambridge University Press; 2011; xv + 282 pp.; ISBN 978-0-521-84157-3; $130.

In long-established fields like fluid mechanics or quantum theory, the contents of introductory textbooks are mostly predictable: The basics are covered in more or less the same order, and while cutting-edge research occasionally gets a look-in (depending on the inclinations of the authors), the contents are far more frequently reworkings of previous textbooks than a synthesis of recent primary literature.

In a field like climate science, however, where there is a much shorter history of textbook writing, much of the subject matter is extracted directly from papers published in the past 10 years. This makes the resulting textbooks far more varied and interesting.

David Neelin's book *Climate Change and Climate Modeling* derives from classes he has given for many years at the University of California, Los Angeles. It covers the basics of climate dynamics, the greenhouse effect, and global warming and leans heavily toward the author's main field of research: understanding the El Niño–Southern Oscillation (ENSO).

Indeed, ENSO is brought up immediately, in chapter 1, as an important mode of climate variability, and ENSO dynamics and prediction are discussed at length in chapter 4. The basics of climate and climate processes are discussed well in chapters 2 and 3. Oddly, large-scale climate modeling is discussed in chapter 5, while much simpler models for the greenhouse effect and climate feedbacks are left for chapter 6. Climate model projections and their evaluation are discussed in chapter 7. The chapters and sections are delineated well enough that classes could study them in a different order. Future updates of the textbook will include an assessment of the model simulations being made for the next Intergovernmental Panel on Climate Change (IPCC) report.

It is incumbent on reviewers to demonstrate that they have read a book carefully by finding typos, and I will not disappoint. At one point, the spring equinox is described as being in April (instead of in March), and there is a minus sign missing from the definition of the u-component of the geostrophic wind. However, these are small issues and are already flagged in the copious and useful online materials (http://www.atmos.ucla.edu/neelin/climatebook).

In terms of treatment of the issues, there is much to be admired in this book. Anyone coming to the subject for the first time will be amply rewarded, though more seasoned eyes will find a few subtleties to quibble over. For instance, the term "radiative forcing" is used inconsistently in the book. Section 2.2 would be much more useful titled "Basics of radiative transfer" rather than "Basics of radiative forcing," especially since the term radiative forcing is not actually defined until section 6.2 (where the IPCC sense of it as an external perturbation to the top of the atmosphere, or the tropopause, energy balance is given). Similarly, the gradients of "radiative forcing" in section 2.4 are really the gradients of insolation. Another issue not well explained is the reason for stratospheric and mesospheric cooling as carbon dioxide (CO_2) increases (it is related to the spectral variation of absorption of CO_2, not the presence of ozone). However,

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having had the wrong idea myself for many years before being pointed to the correct explanation, I appreciate the difficulty in rendering this for a student audience.

No book can contain everything, but there are some components obviously missing from this book. Paleoclimate is given very short shrift, which is a shame because it is paleodata that provide the best constraints on climate sensitivity and out-of-sample evaluations of the skill of climate models. Similarly, the carbon cycle and the long-term fate of current emissions are not really addressed. However, other books exist that deal with these issues (e.g., W. F. Ruddiman's *Earth's Climate: Past and Future* or D. Archer's *The Global Carbon Cycle*) but that don't have descriptions of issues in climate modeling as good as those in this book.

Overall, this book is a positive addition to the library shelf. It is well written, clear, and accessible and fits nicely in between A. Gill's rather more cerebral *Atmosphere-Ocean Dynamics* and K. McGuffie and A. Henderson-Sellers's practical but somewhat dated *A Climate Modelling Primer*. As a textbook, *Climate Change* is not inexpensive, but for a beginning student in this field it will likely repay the investment.

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