

READINGS

BOOK REVIEWS

MODELING UNCERTAINTY IN THE EARTH SCIENCES

Jef Caers, 2011, 246 pp., \$79.95, paperbound, Wiley-Blackwell, ISBN 978-1-1199-9262-2

“**U**ncertainty” is dominating the current discussions of forecasts and projections in the geosciences, especially in anticipation of the release of the new IPCC assessment report. Course offerings of some form of model uncertainty in environmental and Earth sciences are beginning to gain more traction in several undergraduate and graduate degree programs. Therefore, the publication of this book appeals to the zeitgeist.

Uncertainties in the forecasts and projections from days to decades from the forecast systems in the geosciences are in some ways a strength of the system, as they can be harvested for making optimal decisions. However, uncertainty can turn out to be a nuisance if its concepts and relevance are not well understood. There is in fact a growing consensus in the community of Earth system science, especially in weather and climate science communities, that deterministic forecasts are perilous, misguided, and simply wrong. This makes it all the more imperative that students of Earth and environmental sciences are exposed to the concept of “uncertainty” with some rigor. This book offers a good primer for such students who are being introduced to uncertainty in the geosciences.

This textbook is largely targeted toward senior undergraduates and introductory graduate-level students in the Earth and environmental Sciences, where students have already had adequate exposure to statistics. A very nice feature of this textbook is that it is able to address the uncertainty issue in a broader context of the Earth sciences, which would make it relevant to students specializing in meteorology, including climate science, geology, oceanography, and hydrology.

The textbook is self-contained, with the relevant statistical concepts being adequately introduced in the second chapter of the book. Chapter 3 discusses

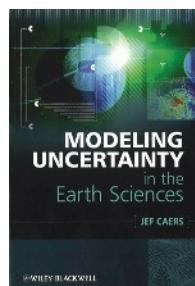
the concept of uncertainty, followed by two illustrative examples in climate modeling and reservoir modeling. Here, I feel that the author could have added some good illustrative figures that would have helped further in understanding the uncertainty issues in climate and reservoir modeling. There is also a notable absence of any discussion on chaos theory.

Chapter 4 discusses the decision modeling process, with very good illustrations of preparing and using decision trees for conducting the cost/benefit analysis, which is used again in a subsequent chapter on value of information (chapter 11), and in the last chapter, which discusses a case study (chapter 12).

Chapters 5–8 are written with modeling of the subsurface in mind. However, some of the aspects explored in chapter 5 that dwell on the diagnosis of the spatial continuity (or discontinuity) have a broader relevance, while in chapters 6 and 7, the discussion on kriging and inverse modeling, respectively, have a wider application in the environmental sciences.

The chapter on visualizing uncertainty (chapter 9) is provided with nice illustrations and a very succinct description of the metrics used to measure uncertainty. However, this chapter—like others in the book—is not inclusive of all the metrics used to measure uncertainty. But it gives enough exposure to the readers on the concept of displaying uncertainty to be able to follow them in other contexts.

Chapters 10 and 11 dwell on modeling the response uncertainty and understanding the value of information, respectively. The main highlight of the book in my opinion is the last chapter (12). This chapter synthesizes the concepts introduced in the previous chapters of the book and applies it to a case study of assessing the risk of contaminant transport to a well, which is a source of drinking water.



Overall, I consider this book to be a good addition to a rather limited choice of books for teaching an introductory course on modeling uncertainty in the Earth and environmental sciences. As the author points out in the preface of the book, this is not an encyclopedia on modeling uncertainty, but rather an introduction to the topic that can

lead the reader to deeper pursuits on modeling uncertainty.

—VASUBANDHU MISRA

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CLIMATE STABILIZATION TARGETS: EMISSIONS, CONCENTRATIONS, AND IMPACTS OVER DECADES TO MILLENNIA

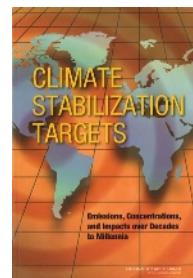
National Research Council, 2011, 298 pp., \$47.00, paperback, The National Academies Press, ISBN 978-0-309-15176-4

The book *Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia* systematically lays out the science and impacts behind different global warming stabilization targets, measured by global mean temperature instead of traditional atmospheric carbon dioxide (CO₂) concentrations. Prepared by the National Research Council and a group of prominent researchers in different disciplines in climate sciences, the book could serve as a benchmark textbook for climate change and its stabilizations in the future.

Currently, the climate science community constantly faces various questions from the media and general public about global warming, thanks to the growing public awareness in the past decade on climate issues. As many of those questions are actually well-

established arguments within the research community, it is becoming more and more evident that there is a major disconnection between the research community and the general public. This embarrassing situation is partially due to the way scientific articles and books are conveyed, which is often too scientific and lacks the straightforwardness necessary for the general public to comprehend. This book, however, is extremely easy to read for a more general and broader range of readers.

The book is beautifully written and well framed as a whole, with a very straightforward structure proceeding from emissions and temperature responses to consequent physical climate change, to the



NEW PUBLICATIONS

ATMOSPHERE, CLOUDS, AND CLIMATE

D. Randall, 2012, 288 pp., \$27.95, paperback, Princeton University Press, ISBN 978-0-691-14375-0

This title looks at how our climate system receives energy from the sun and sheds it by emitting infrared radiation back into space. The atmosphere regulates these radiative energy flows and transports energy through weather systems such as thunderstorms, hurricanes, and winter storms. The book explains how these processes work, and also how precipitation, cloud formation, and other phase changes of water strongly influence weather and climate. It discusses how atmospheric feedbacks affect climate change, how the large-scale atmospheric circulation works, and much more.

THE GLOBAL MONSOON SYSTEM: RESEARCH AND FORECAST (SECOND EDITION)

C.-P. Chang et al., Eds., 2011, 608 pp., \$160.00, hardbound, World Scientific, ISBN 978-981-4343-40-4

This book presents a current review of the science of monsoon research and forecasting. It builds on the concept that monsoons in various parts of the globe can be viewed as components of an integrated global monsoon system, while emphasizing that significant region-specific characteristics are present in individual monsoon regions. Topics covered include all major monsoon regions and time scales (mesoscale, synoptic, intraseasonal, interannual, decadal, and climate change).

JOPLIN 5:41: WHEN A MONSTER STORM SHATTERED A MISSOURI TOWN BUT DIDN'T BREAK ITS SPIRIT

The Kansas City Star, 2011, 222 pp., \$29.95, hardbound, Kansas City Star Press, ISBN 978-1611690170

This title presents the story of tragedy and courage in the face of one of nature's mightiest storms. It collects the detailed coverage by *The Kansas City Star* of the storm that hit Joplin at 5:41 p.m., 22 May 2011, and details the storm's tragic effects and the city's courageous response and the recovery. It includes numerous images of the tornado's aftermath and instructional graphics, including an eight-page fold-out showing the path of the storm through Joplin.

impacts in the future. This clear flow makes the book very easy to follow and, meanwhile, the well-designed figures and some simple analogies adopted by the book make the science easy to comprehend. Elegant examples include the analogy between atmospheric CO₂ and the water in a bathtub in explaining its source and sink, and the explanation of climate sensitivity using the stiffness of a spring. The introductory chapters of the book would be good for graduate-level courses, and the book as a whole would be a great textbook for college students and even interested high school seniors. By touching on some very up-to-date, urgent, and also highly political issues our society is facing, the book can be used as a benchmark for decision-making processes of state and federal governments as well as the whole international community, although the authors emphasized that their findings are “not linked to any particular policy choice.”

One unique aspect of this book is that it first defines the stabilization target using global mean temperature—instead of atmospheric CO₂ concentrations—as the main metric. The temperature target is more intuitive to elaborate potential risks that humanity may be facing with a certain degree of warming. It also allows the assessments of both near-term impacts during the transient period while the CO₂ concentration increases, as well as long-term lock-in consequences after the stabiliza-

tion. In addition, the book promotes the concept of cumulative carbon, which is more directly linked to the temperature response. It is also more relevant to the corresponding policies that governments need to adopt to reduce greenhouse gas emissions and mitigate a certain degree of potential risks of hazardous future impacts.

From the beginning to the end, the book highlights the severity of climate change’s impacts and the urgency for us to take action. By assessing the climate change stabilization targets in the long term (millennia time scale) and in the relative short term (next few decades and centuries), the book shows that climate change will persist for thousands of years even if the emissions were to be halted, and as much as an 80% emission reduction is required to stabilize CO₂ concentrations. The book provides a thorough summary of the likely future impacts of continuing warming, from rainfall to ocean circulation to permafrost to sea level rise to human infrastructure. It is one of the most comprehensive and systematic summaries of all these impacts that I have read. All of this information helps readers—particularly the nonspecialists—to grasp the great landscape of why stabilization is important, and this is the main reason why this book deserves a thorough reading.

As mentioned earlier, the book is beautifully written and well structured. I don’t find many caveats to

ARCTIC CLIMATE CHANGE: THE ACSYS DECADE AND BEYOND
P. Lemke and H.-W. Jacobi, Eds., 2012, 464 pp., \$179.00, hardbound, Springer, ISBN 978-94-007-2026-8

This volume addresses the following major topics: research results in observing aspects of the Arctic climate system and its processes across a range of time and space scales; representation of cryospheric, atmospheric, and oceanic processes in models, including simulation of their interaction with coupled models; and our understanding of the role of the Arctic in the global climate system, its response to large-scale climate variations, and the processes involved.

THE CITY AND THE COMING CLIMATE: CLIMATE CHANGE IN THE PLACES WE LIVE
B. Stone Jr., 2012, 206 pp., \$29.99, paperbound, Cambridge University Press, ISBN 978-1-107-60258-8

This book explores the dramatic amplification of global warming underway in cities and the range of actions that individuals and governments can undertake to slow the pace of warming. A core thesis of the book is that the principal strategy currently advocated to mitigate climate change—the reduction of greenhouse gases—will not prove sufficient to measurably slow the rapid pace of warming in urban environments. The book explains the science of climate change in terms accessible to the nonscientist and with anecdotes drawn from history and current events.

VISUALIZING CLIMATE CHANGE: A GUIDE TO VISUAL COMMUNICATION OF CLIMATE CHANGE AND DEVELOPING LOCAL SOLUTIONS
S. R. J. Sheppard, 2012, 514 pp., \$79.95, hardbound, Routledge, ISBN 978-1-84407-820-2

Using visual imagery such as 3D and 4D visualizations of future landscapes, community mapping, and iconic photographs, this book demonstrates new ways to make carbon and climate change visible in our own backyards and local communities. Extensive color imagery explains how climate change works where we live, and reveals how we often conceal, misinterpret, or overlook the evidence of climate change impacts and our carbon usage that causes them.



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REANALYSIS

Looking back at the *Bulletin* of October 1948:

IOWA GRASSHOPPER FORECAST MADE FROM DEGREE-DAYS

In cooperation with Iowa State College, the Des Moines Weather Bureau office prepared special temperature data for Dr. Harold Gunderson, Extension Entomologist, which enabled him to give Iowa farmers approximately one week's warning of the extensive grasshopper hatching this spring. We computed daily "Degree Day" data for four selected Iowa climatological stations, using a daily mean temperature of 60°F as a base and keeping running totals for each station. When the accumulated Degree Days approached 160, extensive hatching of grasshopper eggs occurred.—*Courtesy, U. S. Weather Bureau*

—*Bull. Amer. Meteor. Soc.*, **29**, 394

this statement. One aspect in which the book could improve is to pull out the definitions of some terms earlier in the text. For instance, the definition of "transient climate response" seems to first appear on page 22, but the term shows up many times in earlier sections. An early and clear layout of the terms would make the book more easily approachable to readers, particularly to nonspecialists. Also, although the early chapters (the synopsis, summary, overview of section 1, and introduction of section 2) serve different functions, they are a little redundant and repetitive.

Overall, I recommend this book to a broad range of readers, from college students and climate researchers to decision makers and those in the general public who are interested in climate change and climate stabilizations. Under the current political atmosphere, such a book, written by some of the most recognized scientists in this field, should clear some of the mist cast in front of the public's eyes and provide a solid guideline for the future decision-making processes. It will help the public to be aware of what we should do in this critical "Anthropocene" era, which could lead humanity either into prosperity or into severe and irreversible trouble.

— FUYU LI

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