

## Book reviews

**Paleoclimate, Global Change and the Future** edited by K.D. Alverson, R.S. Bradley and T.F. Pedersen. (Springer, 2003). ISBN 3-540-42402-4. 221 pages. 79.95 Euros (hardcover).

Paleoclimate is back in the news. For example, several controversial articles, as well as Bjorn Lomborg's book *The Skeptical Environmentalist*, have recently questioned the climate reconstructions of the past millennium. These proxy temperature records have been important in demonstrating that much of the recent warming is probably anthropogenic (forced mainly by greenhouse gas increases), so any criticism of them is assured of prominence in the media. Meanwhile, a number of geoscientists (particularly in Australia) continue to argue that their discipline is underrepresented in the climate debate and that an even longer term perspective is needed to assess recent and future climate change.

*Paleoclimate, Global Change and the Future* demonstrates that objective, quantitative paleoscience does indeed contribute to the science and debate on climate and global change. It concentrates on the Quaternary, the Holocene and the past millennium. This period may not satisfy all geoscientists but it is long enough to contain a large range of past natural and anthropogenic changes that are relevant to future change processes.

This recent geological past is the domain of the IGBP PAGES (Past Global Changes) program. The book represents a ten-year milestone for PAGES. Editors Alverson, Bradley and Pedersen have compiled an impressive review with eight chapters, 88 figures (mostly colour), two appendixes and 36 pages of references. The chapters are generally comprehensive and up to date, reflecting the calibre of their authors.

Chapter 1 by Oldfield and Alverson emphasises the social and economic relevance of paleoenvironmental research. This reflects how the discipline has matured. Australian researchers are increasingly being asked to demonstrate such relevance and may benefit from the arguments made in this chapter. Several good examples are presented, although the language can be rather clichéd.

The history of atmospheric composition is presented in Chapter 2 by Raynaud and colleagues, who helped pioneer the use of ice cores more than 20 years ago. They discuss the evidence of climate change, cli-

mate forcing and biogeochemical cycling in the records of atmospheric composition changes (gases and aerosols). However, there is little discussion of some important recent advances. Remarkable new insights on the drivers of climate and the controls on atmospheric CO<sub>2</sub> during warming episodes have recently come from accurately dated and well-resolved ice records. Advances have also been made in determining the causes of the atmospheric composition changes, using isotopic measurements and biogeochemical modelling. While Chapter 4 covers some of the CO<sub>2</sub> issues, the omission of these advances in this chapter make it already appear rather dated.

Chapter 3 by Labeyrie et al. is a lucid and very detailed account of late Quaternary climate dynamics. It outlines the evidence (from most available sources of paleodata), impacts and likely causes of glacial features such as Dansgaard-Oeschger cycles and Heinrich events. It then moves through (touching only lightly on the Holocene) to the dynamic modes of more recent climate such as El Niño, North Atlantic, Arctic and Antarctic Oscillations.

In Chapter 4, Pederson et al. do a good job of describing the advances in understanding the carbon cycle during glacial-interglacial changes and the Holocene, particularly in the ocean.

Chapter 5, headed by Overpeck, is equally strong on the past terrestrial biosphere dynamics and climate with a view to likely future changes.

The past millennium is the baseline on which the recent atmospheric changes and warming are often assessed and is the subject of Chapter 6. Bradley et al. cover evidence of these changes in both hemispheres with frequent reference to the data's limitations. This chapter in effect addresses the concerns of many warming sceptics even though it was written before their heightened activity of the past year.

Chapter 7 looks at the role of humans in past and future environmental changes. Oldfield and Dearing again bridge across to the human aspects and address the issues of sustainability and vulnerability.

The summary chapter by the editors brings to life some of the impacts of past observed changes and future predictions. It unfortunately contains rather a lot of motherhood statements ('without water, civilization cannot exist', 'change is normal'). The authors suggest that the messages in paleoclimate must not be ignored. A more useful conclusion might include practical ways that society, from scientist to policymaker, may benefit from the diverse paleoclimatic evidence presented in this book.

The text is descriptive in nature and does not serve as a textbook of basic principles or quantitative methods. Modellers may have to read and interpret the detail carefully to extract the sort of information they need. Likewise, the producers of climate and other proxies may not readily find which parameters the modelling community require from their measurements. However, useful guides for accessing the data of the PAGES program are given in the two appendixes.

The book condenses a huge amount of information so it is not surprising that there are also a number of minor errors. It has considerable content and is good value even at about 80 Euros – a stretch for undergraduate students, a must for many libraries and hopefully a tempting purchase for policymakers.

#### Dr David Etheridge

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**Handbook of Weather, Climate, and Water: Atmospheric Chemistry, Hydrology, and Societal Impacts** edited by Thomas D. Potter and Bradley R. Colman (Wiley-Interscience, John Wiley and Sons Inc., 2003). ISBN 0-471-21489-2. US\$150.00 (hardcover).

This two-volume Handbook covers topics in atmospheric dynamics, the climate system, physical meteorology, weather systems, measurements, atmospheric chemistry, hydrology, and societal impacts. This review covers only the volume that contains the sections on atmospheric chemistry, hydrology, and societal impacts.

The stated purposes of the Handbook are, ‘...to provide an up-to-date account of the sciences that underlie these important societal issues, so that both citizens and decision makers can understand the sci-

entific foundation critical to the process of making informed decisions,’ and ‘... to provide a comprehensive reference volume for scientists who are specialists in the atmospheric and hydrologic areas’.

The overview chapter of the atmospheric chemistry section provides an interesting history of the development of the field and serves as a very good introduction. The next ten chapters deal with the chemistry of oxygen, nitrogen, carbon, and sulphur and their transport. Thereafter chemical processes in the boundary layer are discussed (photochemical smog, biomass burning, acid rain, and visibility) and the section concludes with chapters on the chemistry of the stratosphere (circulation, ozone and aerosols).

As I am a hydrologist with only the basic knowledge of physical chemistry provided by undergraduate engineering course work, I tested the first purpose of the Handbook by reading the section on atmospheric chemistry in detail. In general I found I was able to follow the argument in each chapter and learn a great deal about the complexities of atmospheric chemistry in the process. However, I suspect that many citizens and decision makers will have neither the chemistry nor the fortitude required to make even the material presented in the overview accessible, so the first objective might be a bit ambitious for this particular section.

The section on hydrology covers material that is closer to home for me, and I was impressed by the list of hydrological luminaries who contributed material. The overview introduces the hydrological cycle and discusses the role of hydrology over the range of scales from local to global. The overview is written at a level that can be understood by the general public (my wife found it invaluable when teaching the hydrological cycle to her Grade 6 class) and manages at the same time to be thought-provoking and non-trivial.

The section then works through the various fluxes in the hydrological cycle (rain, snow, water vapour, ground water and surface runoff) and concludes with a series of chapters on flood forecasting and statistical simulation. The emphasis in this section is on mathematical description of the various physical processes that drive the fluxes in the hydrological cycle and therefore it provides a solid foundation on which to build an understanding of the issues in hydrology. Each chapter has an extensive list of references which provide an entry point to both the state-of-the-art and the canon of hydrological literature. The chapters on the measurement of rain and snow are focused on the situation in the United States, which reduces their interest for the rest of us. The chapter on surface runoff generation

by Keith Beven is a particularly clear summary of the current thinking on how rainfall arrives in our rivers. The final chapters in the section cover hydrological modelling and statistical techniques that have been used to characterise and simulate hydro-climatic variables. The approach to modelling that is used in hydrology is often quite different to that used in meteorology. The chapter on hydrological modelling for runoff forecasting by Hoshin Gupta provides a good overview of hydrological models as well as an excellent discussion on model complexity that should be of interest to the modellers of this world.

The final section in this book covers societal impacts, starting with an overview and then presenting a number of case studies covering a wide range of topics. The case studies in this section are all very interesting and have a true international flavour to them. For me there are three outstanding chapters in this section. First, coping with climate variability in developing countries by Thomas Downing and Yoland Stowell gives a very clear analysis of factors that affect the socioeconomic vulnerability of a population to climatic variability. The second highlight for me is the study on the impact of flood mitigation on the Mississippi by Stanley Changnon, who characterises flood mitigation as a titanic struggle, and gives a very interesting account of the efforts over the past 150 years to minimise the cost of flooding, before concluding that these efforts by and large have failed. The third highlight for me was the chapter by Kenneth Broad of the impact of ENSO on Peruvian fisheries. This chapter describes the impact of ENSO on the various sectors that are involved with the Peruvian fishing industry and then examines the policy implications of climate information and forecasts. The most interesting part of this chapter for me was the final section that describes the attempts at pressuring scientists to produce forecasts that could then be manipulated so as to produce outcomes that were favourable for a particular company or sector.

The material covered in each chapter of the book is focused on the fundamentals rather than the cutting edge and therefore the material will continue to be both relevant and useful for some time. The goal of providing a comprehensive reference volume is met through an extensive list of references, published on or before the year 2000, at the end of each chapter. The figures in the book are often below the usual standard of reproduction, which is disappointing for a book that is so good otherwise. There is reference to an ftp site and I visited the site expecting to get more or less an electronic version of the book, but found instead two zip files containing the

figures so that was a disappointment. Overall, I rate this book as very good, but rather than buy it for myself I would probably see to it that our library obtains a copy.

**Alan Seed**

*Alan Seed is a research scientist at the Bureau of Meteorology Research Centre. His undergraduate training was in hydrology and he now works in the Weather Forecasting Group on radar rainfall estimation and quantitative precipitation nowcasting. He is associated with the Cooperative Research Centre for Catchment Hydrology and leads a project on hydrological modelling for weather forecasting within the Climate Variability Programme.*

**Waves in the Ocean and Atmosphere: Introduction to Wave Dynamics** by Joseph Pedlosky (Springer, 2003). ISBN 3-540-00340-1. US\$49.95 (hardcover).

Many of the complex motions of the atmosphere and ocean can only be fully understood through a knowledge of wave dynamics. The stratospheric Quasi-Biennial Oscillation, El Niño, quasi-geostrophic Rossby waves, stratospheric sudden warmings, surface ocean waves, oceanic and atmospheric tides, and waves in the lee of topography, all require a sound knowledge of wave dynamics to be understood and predicted. Joseph Pedlosky's new book, *Waves in the Ocean and Atmosphere: Introduction to Wave Dynamics*, provides such a working knowledge.

Aimed at the level of first-year graduate students in the United States, or equivalently an honours-year student in Australia, the book commences with an overview of the basic wave concepts of phase speed, dispersion relation and group velocity. As the reader's toolset for analysis is increased, specific wave phenomena and related concepts are then examined, including surface gravity waves, internal gravity waves, lee waves, waves in the presence of rotation, channel modes, Rossby waves, quasi-geostrophic waves, Laplace's tidal equations, equatorially trapped waves, wave-mean flow interaction, and unstable waves. Professor Pedlosky expertly leads the reader from one subject to the next. True to the form gained

from his previous well-known books, Pedlosky's treatment of the subject is rigorous. For example, time is spent examining the approximations that are often made within each set of equations before they are solved. Yet important physical interpretation of the mathematical results is still an emphasis.

Interestingly, the book is arranged as a set of twenty-one 'lectures', each of a length designed to be covered in a standard hour-long class. This arrangement is a result of the source of the book's material, being Professor Pedlosky's lecture notes from the core course on the subject at the Woods Hole Oceanographic Institution, as he has taught for a number of years. The arrangement doesn't make the book any less useful for the non-student, however, as the material flows in a logical order, and is provided with a useful contents page and extensive index. On the contrary, the lecture-notes style of the book has allowed Pedlosky to provide an enjoyable informality in the text. Quoting an example from the section on baroclinic instability, 'for those of you starting graduate school, it will give you a standard to strive for to know that this represented Charney's Ph.D. thesis'. I can imagine the attentive response of the students when told of the comparative work of one of the forefathers of the field.

Given the originally intended audience for the book, that is, students in the Joint Program in Physical Oceanography of MIT and Woods Hole, the material has a rather more oceanographic theme than atmospheric. For example, internal gravity waves are derived from the perspective of the ocean, and the typical scales expected for internal equatorial waves are only given for the ocean. However, even though I am primarily an atmospheric scientist, I still found the book to be useful, and will be happy to own a copy. For the price (around a very reasonable US\$50), the book is cheaper than any other on atmospheric or oceanic dynamics that I know, so I imagine it will become a common sight on the shelves of the more dynamically minded researchers and lecturers.

Despite the book's readability and usefulness,

compared to the much-used books of Holton (*An Introduction to Dynamic Meteorology*) and Gill (*Atmosphere-Ocean Dynamics*), I feel that this new book is less likely to be assigned as a required text of Australian university courses. This is more a reflection of the limited extent to which formal coursework is provided in Australia compared with the broad range of selection offered in the United States. Perhaps in the more oceanographic-minded of the Australian academic departments it will find a place as a required text. If it does, the book's arrangement as a series of lectures will make the material easily applied. Indeed, some of the lectures (e.g., those on Rossby waves) could be effectively used on their own. The provision of a number of problem sets at the end of the book (not at the end of each chapter, as advertised on the back cover) is a further useful aspect for a student and teacher.

On the whole, this book is a welcome addition to those that already cover the topic of waves in the ocean and atmosphere. It is particularly nice having all of the wave-oriented material covered in the one place. Perhaps my only gripe with the book is that it could have contained more examples of wave phenomena from observations; very little real data is quoted or shown. Nevertheless, I heartily recommend it to those who want to really understand the many wave-like atmospheric and oceanic motions that exist, and the important phenomena (as listed above) that result.

#### **Matthew Wheeler**

*Matthew Wheeler is currently in the Climate Forecasting Group of the Bureau of Meteorology's Research Centre, and has previously held positions at the University of Colorado and the US National Center for Atmospheric Research. His research work has primarily concerned large-scale atmospheric circulations, and in particular he has made advances in the understanding of the role of equatorially trapped waves.*