

## Review

OERLEMANS, J. 2001. *Glaciers and climate change: a meteorologist's view*. Lisse, etc., A. A. Balkema Publishers. xii + 148 pp. ISBN 90-265-1813-7, hardback. €59.00/\$US65.00/£39.00.

THE persistent expansion of glaciological research has made it more difficult for books with broad themes like "glacier physics" to cover their subjects. Fortunately, a number of more focused texts and edited volumes have recently been published on a range of subjects, from ice dynamics to glacial geomorphology. To this literature, Johannes Oerlemans has now added a delightful, informative and compact book entitled *Glaciers and climate change*. An official subtitle, *A meteorologist's view*, helps to clarify the book's aims and personalized perspective; it is a pity that the subtitle does not appear anywhere in the book itself.

This book is not a comprehensive treatment of the interaction of Earth's glacial systems with the climate, as it includes little discussion of the polar ice sheets, the Pleistocene ice sheets, the impact of ice sheets on atmospheric circulation and global radiation balance, or ice-core paleoclimatology. Instead, the author focuses on the advance and retreat of valley glaciers, and on their interaction with the local atmosphere. This narrow focus allows him to build a very engaging extended discussion of the subject. Within its aims, the book is a solid, clever and useful contribution.

*Glaciers and climate change* is well written. Clear and direct language helps lead the reader through the subject without struggle, and the structure of the book is commendable: each chapter is logically connected to earlier ones, and each makes an important contribution to the extended discussion. Each major concept is developed from simple qualitative statements using quantitative models of increasing complexity, and illustrated with data and drawings. Owing in part to this clarity of presentation, the book will not only be useful for dynamic glaciologists and meteorologists but will also be comprehensible and informative for geomorphologists, glacial geologists, and others who do not specialize in glacier flow or energy-balance physics.

The reader should be forewarned that the presentation includes a mixture of well-established fundamentals, methodologies for specific analyses, results from the author's own research, and pure conjecture. This mixture generates an almost conversational style that is laudable for keeping the reader attentive. It may also generate some confusion in readers with little background in the field.

A satisfying aspect of *Glaciers and climate change* is the abundant discussion of applications to real, specific glaciers. The reader is taken beyond the realm of general concept to learn specifically about the retreat of Rhonegletscher, the trimlines of Nigardsbreen and the climate sensitivity of Franz-Josef Glacier, to give three examples out of many.

Chapters 1 and 2 motivate the book and summarize basic concepts of mass balance, ice flow, and reconstruction of glacier changes. This presentation of very basic concepts makes the book suitable for readers with no prior knowledge of glaciers. In fact the only prerequisite for understanding this book is a broad understanding of elementary physics and calculus.

Chapter 3 offers an informative introduction to valley-glacier microclimates, structured as analysis of the surface energy budget. Highlights include the analytic model for katabatic winds, and the abundant illustration of concepts using the author's own data from sites on Morteratschgletscher. The microclimate material is subsequently used in discussions of mass-

balance modeling, the subject of chapter 4. Here simple models are used to illustrate, for instance, the important role of albedo variations in the vertical profile of specific balance, and to characterize simple relationships between mean annual climate and the sensitivity of mass balance to climate changes.

Glaciers start to flow in chapter 5, a summary of ice-dynamics concepts used in the valley-glacier climate-response modeling of later chapters. Dynamic glaciologists will be self-righteously horrified to see basal sliding parameterized as a function of only slope and ice thickness. The author anticipates such a reaction, and early in chapter 6 demonstrates that the details of the sliding parameterization are not overly important in the sorts of analyses discussed here. A numerical flowline model and a simple algebraic analytical model illustrate the relationship of glacier length and equilibrium-line altitude, and contribute to a very useful discussion of glacier response times. Important details are added to the glacier models in chapter 7, to account for effects of planform geometry. The high sensitivity of narrow valley glaciers draining broad accumulation basins is highlighted.

Chapters 8–10 form the heart of the book. Chapter 8 features numerical models of four specific "real glaciers", with emphasis on response times and reproduction of known advance and retreat histories. Chapter 9 investigates the power and difficulties of the inverse problem, inferring climate changes from glacier fluctuations. The scope of inquiry is geographically expanded to global scale in chapter 10. The contribution of worldwide alpine glacier retreat to sea-level rise in the last 150 years is assessed, and observed glacier retreat used to reinforce estimates of global warming. Here, just four pages are devoted to the polar ice sheets, reminding the reader that this book is not, and does not claim to be, a comprehensive discussion of "glaciers and climate change".

Chapter 11 asks how alpine glaciers worldwide will respond to continued global warming. Research glaciologists will question the absence of coastal Alaskan, Canadian Arctic and Himalayan glaciers from the analysis, but all readers will be stimulated by the attempt. The book closes with a brief chapter on tools and methods for future glacier research, with due emphasis on remote sensing.

I counted only about 20 minor typesetting errors in the whole book, including some figures with incomplete axis labels, and mis-referenced equations or symbols. The reader is likely to disagree with the author about some aspects of the analyses, but this seems inevitable when the book provides such a personalized view of the subject and does so by interweaving original research with basic concepts. Overall, *Glaciers and climate change* is an excellent and informative text focusing on valley-glacier fluctuations and microclimate, and is enjoyable to read. I recommend it to all specialists and students of glacial systems, and to any physical scientists interested in glacial aspects of environmental change. The book price is quite reasonable for professionals, but a bit high for students.

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