Review

MARSHALL SJ (2011) *The cryosphere*. Princeton University Press, Princeton, NJ. 312pp. ISBN 978-0-691-14525-9, hardback, US$80/£55; ISBN 978-0-691-14526-6, paperback, US$24.95/£16.95

In issue 207 of the *Journal*, Will Harrison reviewed a book with a similar-sounding title to this one (Barry and Gan, 2011), and it is curious that the two books should be published so close together in time. Perhaps this reflects the dramatic growth in interest in the state of the cryosphere and its role in the climate system, or perhaps it is just coincidental. In any case, inspection beyond the title and chapter headings indicates that any perceived similarities in the content, scope and audience of these two books are illusory. They are serving very different roles. The publication reviewed here is the third in a series entitled 'Princeton Primers in Climate', the earlier two covering the global carbon cycle and the oceans respectively. It is a further testament to the importance of the discipline that this volume precedes the, presumably inevitable, book on the atmosphere in this series! The back cover describes the book as 'the ideal first place to turn to get the essential facts, presented with uncompromising clarity' – a bold claim. I feel, however, that it is a fitting description, and it places the book in a unique position in the canon of recent literature on the cryosphere. It is neither a textbook nor a popular commentary but lies somewhere between the two.

To propose to cover all aspects of the cryosphere in less than three hundred pages of a single-authored book is a bold endeavour and daunting challenge, and few would claim to be able to successfully achieve this. But if anyone can, as the preface intimates, a Canadian can, and the author's enthusiasm for and fascination with the subject matter is apparent right from the beginning. The style is engaging and entertaining while being informative and clear at the same time. The purpose is to introduce the reader to the most salient and key concepts rather than cram with detail and this makes for a very readable approach. It was a pleasure rather than an effort to read. The downside is that technical detail is sparse. It is clear, however, that this is not intended to be a weighty reference text. The book is the same size as a typical paperback novel, with a layout to match. Technical language is kept to a minimum and the figures are illustrative rather than definitive. There is a short glossary and index at the end, with the former defining basic terms (e.g. orbital variations; West Antarctica).

The book has nine chapters, starting with the physical properties of snow and ice including thermodynamics. Chapter 2 covers the key characteristics of snow and ice: crystal structure, density, thermal properties and albedo – all in 25 compact pages. Chapter 3 focuses further on thermodynamics, including englacial temperature profiles, but predominantly considering the surface energy balance and the factors that influence it. Chapters 4–7 describe the various components of the cryosphere in more or less detail, starting with seasonal snow and freshwater ice. The interaction of snow cover (and other components of the cryosphere) with the biosphere and the rest of the climate system is tackled toward the end of the book, and in this chapter the focus is on formation, decay and observations. Chapter 5 discusses sea ice, including variations in extent in both hemispheres, thermodynamics and a few pages on the physical properties. For reasons that are not entirely clear, glaciers and ice sheets follow in chapter 6. At 38 pages this is one of the longest chapters, but still introductory rather than authoritative in content. The first part discusses the geographical extent and volume of glaciers and ice sheets, followed by sections on glacier mass balance and dynamics, providing an introduction to concepts that are developed later. Chapter 7 provides a short overview of permafrost.

The final two chapters, 8 and 9, are dedicated to the role of the cryosphere in the rest of the climate system and, I sense, underpin the motivation for this book and the series in general. Chapter 8 tackles cryosphere/climate processes such as the impact of snow and ice on the planetary albedo. The final chapter considers how the cryosphere has changed in the past, including for example the Snowball Earth hypothesis, the inception of glaciation in Antarctica, glacial/interglacial cycles and Milankovich cycles and a brief discussion of recent changes during the instrumental record. There is rather little on predictions of future change and this may be a wise decision as it is a rapidly evolving topic. Nonetheless, I suspect it is one that readers of a book such as this would be eager to learn about, and some discussion of future projections would have been welcome. Some of the general issues associated with modelling future changes are touched on, but the cited references focus on observations rather than prediction. At the end of the book is an annotated bibliography covering each chapter and including further reading and the references cited earlier. The former is particularly useful if you wish to go further and deeper into a topic and includes some of the 'standard' texts in glaciology alongside some historic classics and seminal works.

So who would or should read this book? It is well suited to a geoscientist unfamiliar with the topic, or an interested non-professional with a basic understanding of the climate system. It is a good starting point for an undergraduate embarking on some flavour of environmental sciences degree that includes the cryosphere. It could potentially be useful to the professional glaciologist wanting a handy primer on an unfamiliar part of the frozen planet, although this is not its core market. If you want a readable, engaging, not-too-technical introduction to the cryosphere then this is the book for you.

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REFERENCE

Barry R and Gan TY (2011) *The global cryosphere: past, present and future*. Cambridge University Press, Cambridge