Review of *Global outlook for ice and snow*, by United Nations Environment Programme (2007). Arendal, Norway: UNEP/GRID-Arendal. 235 pp. ISBN 978-92-807-2799-9. (Available as a free download in pdf format at http://www.unep.org/geo/geo_ice/)

This book provides an excellent overview of the recent research results on the cryosphere. For the non-specialist, in particular, it is a useful introduction to the subject, and provides some of the basic facts and statistics related to the cryosphere. Each of the components of the cryosphere is reviewed in a chapter or subchapter: snow, glaciers, ice sheets, sea ice, frozen ground, and lake and river ice. These chapters include a description of the cryospheric components, geographical locations and the future outlook. In addition, most sections include discussions of how each component relates to biology, ecology and human activity. Other chapters provide a general introduction to the cryosphere, to climate models and to sea level.

The authors are experts in their field, and much of the information contained in this book is similar to what can be found in the recently released Intergovernmental Panel on Climate Change fourth assessment report (2007). However, the presentation here is much less detailed and is aimed at the non-specialist. The layout of the book is well done, and the shaded boxes provide concise tutorials, or explanations of specific topics. It is not necessary to read the book from start to finish—it is easy to jump around in the book, although a glossary and a list of acronyms would have been helpful additions for newcomers. The wide range of related subjects will ensure that even many specialists in the field will find something new or different. Interesting and relevant illustrations and photographs are interspersed throughout the book. The global nature of the cryosphere is emphasized with the handy map inserts.

The cryosphere is a complex topic, and it is not possible to cover all of the information in detail. Readers should remember that research in this field is ongoing, with new results frequently published; predictions, trends or forecasts in particular need to be used with caution. For example, several publications with estimates of future sea-ice extent have been published since this book. Ongoing research and updates to remote-sensing algorithms (e.g., snow cover and sea-ice concentration) may result in revisions to some of the historical data. In addition, because of the need to be concise and accessible to a general audience, some of the information may not be complete, or does not reflect the entirety of the work that it references. Consequently, the primary sources should be consulted for details or any caveats if specific information is required.

Climate models are briefly described in Chapter 3. More details are mentioned in some of the other chapters. They relate to that specific section of the cryosphere. This is obviously not meant to be a full review, but the diagram and description of feedbacks (3.6) is particularly germane and is a useful reference while reading other sections of the book.

Chapter 4 discusses snow on land, and presents a global view of snow-cover extent based on satellite data, with only a brief mention of regional snow-cover results. It includes a nice overview of the impact of snow on ecosystems. The book also discusses the impact of snow on human activities; the discussion on water resources is complemented by a similar discussion in Chapter 6b on glaciers and ice caps.

Chapter 5 on ice in the sea provides excellent background information to much of the recent press reports about the reduction in Arctic sea-ice extent. This chapter focuses on Arctic sea ice, which is both a reflection of the present state of knowledge and of the interest of much of the research community. Trends and changes are only discussed and plotted in detail for the Arctic situation. Less attention is paid to Antarctic sea ice. The discussion of the indigenous people of the Arctic and their reliance on sea ice in many different ways is well written and provides a range of examples. The biological variety in the sea-ice zone is well presented.

The section on ice sheets in chapter 6 seems a bit thin, and focuses primarily on mass-balance estimates. It does an excellent job of summarizing the recent estimates of total mass balance using a variety of techniques. However, it does not present the recent trends in surface melt of the Greenland ice sheet, or the estimates of precipitation on the Greenland or Antartic ice sheets. The explanation of ice-sheet physics is brief compared with the other components of the cryosphere, and there is virtually no description of the ocean–ice interaction under ice shelves or at the margins. Although Fig. 6A.1 nicely shows the different components of an ice sheet, more description to accompany the diagram would have been helpful.

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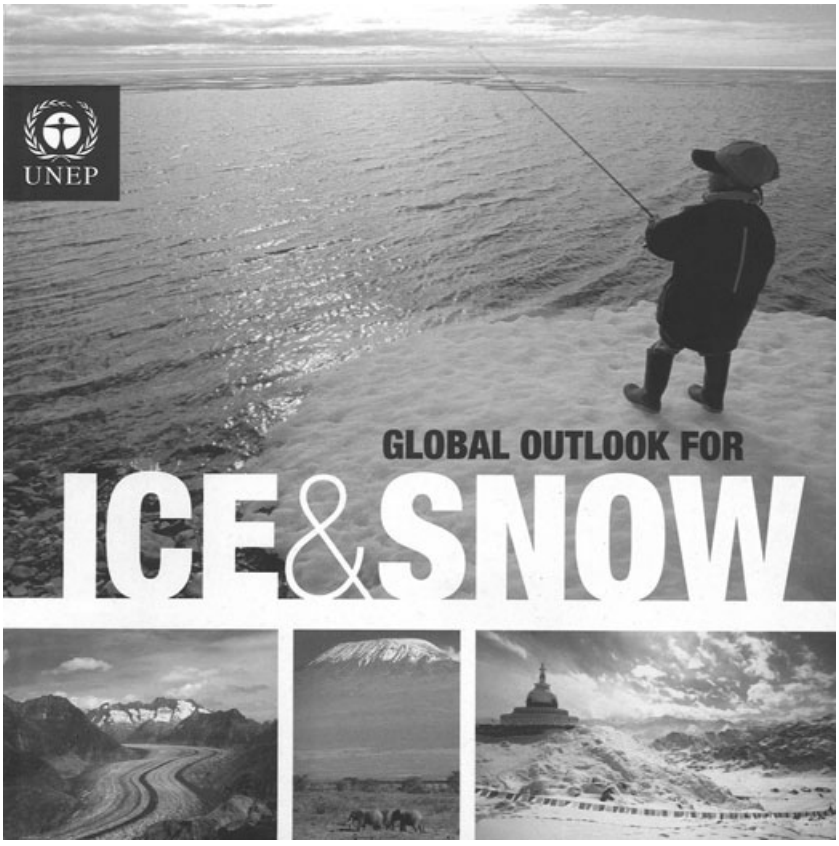

The section on glaciers and ice caps provides a brief summary of the different types of glaciers and ice caps, and presents the observed changes since the last ice age, with more attention given to the past few decades. This is the longest section in the book. It provides a separate, detailed description of most glaciated regions around the world, including the water-supply requirements that are dependent on glaciers. There are some excellent images depicting historical glacier changes, and good descriptions of avalanches.

The section on ice and sea level includes considerable material that is not directly related to the cryosphere. It is difficult to discuss sea level without describing the non-cryosphere components. The first part of the chapter summarizes the estimates of sea level, both in the past in and future projections for the different components (ocean thermal expansion, glacier melt, land water storage, etc.). Because these estimates are calculated for different time periods, and with varying degrees of accuracy and using different assumptions, the reader needs to be careful when comparing the results. The second half the chapter is devoted to adaptation, mitigation and vulnerabilities related to sea level. Although this is an interesting subject, this lengthy discussion seems incongruous compared with the rest of the material in the book, which is focused more on observations and predictions.

Permafrost is covered in Chapter 7, which summarizes the location and surface temperature of permafrost at present, and the expected changes from models. The discussion of methane emissions from themokarsts and the role of permafrost in the carbon cycle is informative, and the authors do an excellent job of linking this with the rest of the climate system. There are many graphic photos depicting the impact of melting permafrost on the landscape, infrastructure and buildings. There is a clear illustration and explanation of the subsurface temperature characteristics in mountain regions.

River and lake ice, the subject of the next chapter, covers one of the more relevant cryosphere components for people living in cold regions. This is where much of the in situ data are available, and where satellite data are not as useful because of low spatial resolution. This is apparent on the global map, where it is difficult to find the locations of lake and river ice due to coarse resolution. The chapter is packed with information, but more description would have been nice. I had to find an atlas to discover the location of the lakes and rivers in Fig. 8.1,

and it is not clear what conclusions can be drawn from the data about what changes have been observed. The data in many of these figures ends in the mid-1990s, leaving the reader to wonder what has happened in the last decade. There is an interesting description of a delta pond system, as well as the impact of lake and river ice on residents of the region.

The final discussion on policy and perspectives contains some closing remarks. The essays from people affected by a changing cryosphere provide interesting personal insight into the complex issues involved in addressing some of the issues. Although the rest of the book typically has a global focus, these perspectives contain a more local or regional emphasis and put a human face to the challenges.

Unfortunately, there is little information about the palaeo-record. Although it is mentioned in a few places (most usefully in the section on sea-level rise) and the inside back cover contains some figures, more description of prior ice ages, or of the use of ice cores as historical records, would have been helpful to put the more recent data in context. There is also little or no information about icebergs or ice shelves.

In summary, this book is recommended for anyone with a general interest in the topic, including scientists who want more background about related research outside their specific disciplines. The book is largely free of substantial errors, and is available online, making it an excellent accessible resource.

Reference

Intergovernmental Panel on Climate Change 2007. *Climate Change 2007—the physical science basis. Contribution of Working Group I to the fourth assessment report of the IPCC* . Cambridge: Cambridge University Press.