



The global cryosphere - past, present and future, by Roger G. Barry & Thian Yew Gan, 2011. Cambridge University Press (www.cambridge.org). 472 pages. Hardback, price USD 130.00, GBP 80.00; ISBN 978-0521-76981-5. Paperback, price USD 80.00, GBP 42.50; ISBN 978-0521-15685-1. E-book, USD 64.00, ISBN 978-1139-12602-1.

The global distribution of the cryosphere components, shown in this book on a map of the world in Fuller projection, is most impressive; the cryosphere covers up to about 15% of the Earth surface, which means more than a third of all land area. The simple arrangement of categories like snow, sea ice, ice sheets, glaciers and ice caps and various permafrost types in comparable areal settings makes one realize how universal the cryosphere is, forming part of the global climate/ocean/lithosphere system. Not only is the extent of the cryosphere itself so fascinating, but so are the wide variety of processes that are involved in the evolution of this natural environment. In addition, the map gives an impression of present-day operations and forthcoming events, and also of the interaction with human activity. Since Antoni B. Dobrowolski (1923) launched the term 'cryosphere', several big steps forward have been made regarding the understanding of the 'laws' controlling the way in which its components work.

In my opinion, the book is not only advisable reading for courses at upper undergraduate and graduate level or as a handbook for earth-science and technology specialists (as indicated in the preface), but also a comprehensive, well thought-over guide into the intriguing frozen world. The authors, both with a good reputation in the science of cold regions and in cryology, distinctly profit from their extensive scientific and educational experiences gained during many years of field campaigns in polar regions, teaching and management practice. This is expressed by, among other things, the number of references to their own publications on cold-region climate, climate changes, snow- and ice-related processes, snow hydrology and remote sensing; they form some 2% of the approximately 100-page reference list! This reflects the authors' expertise in presenting cryospheric research results, which can be ascribed to their activities - in both North America and Europe - as professors and visiting lecturers who have given numerous courses.

Four main parts build the book. The first and second parts, which are related to the description of terrestrial and marine segments of the cryosphere, respectively, deal with the present-day situation, following a process-based approach. In each of the eight chapters that constitute these two parts, the history of recognition of, and research into, particular components is dealt with first, providing information, like the first description of snowflakes by Kepler in the 17th century, the founding of the first institute for avalanche studies in Davos (Switzerland) in 1936, the exploration of the Greenland and Antarctic ice sheets, the ice-core drillings and the scepticism about frozen-ground features extending almost until the second half of 19th century. These historical aspects are followed by extensive descriptions of the physical and chemical properties of the cryosphere, together with their geographical distribution.

Part I of the book starts with two chapters that deal with snow formation, snow covers and their changes (with emphasis on terrestrial snow covers), followed by descriptions, highlighting avalanche behavior. The two following chapters discuss glaciers and ice caps (Chapter 3) and ice sheets (Chapter 4) as snow-cover derivatives. Apart from ice-mass characteristics and an outline of mass balance calculations, important issues of glaciers and ice-sheet modeling and changes are raised. The most recent views on the Greenland Ice Sheet and Antarctica are briefly but concisely presented. Chapter 5 is devoted to frozen ground and permafrost; here, the terms 'geocryology' and 'cryopedology' are introduced. The problems related to definitions, as well as to the extent and thermal relationships of solid-state water in the lithosphere or the absence of water, at temperatures just below 0 degrees C, are discussed; permafrost models and geomorphological features referring to permafrost are also presented. The final chapter of the first part (Chapter 6) deals with fresh-water ice and touches the main problems of lake and river freezing and thawing. The most important issues discussed here are the state of lake water at low temperature and the behavior of rivers during successive stages of ice-cover development and its degradation with phases of onset, drive, ice-jam formation and wash. A special discussion is devoted to the interesting phenomenon of icings (Aufeis, naled).

Part II of the book deals with the marine cryosphere. This part is relatively small and consist of only two chapters ('Sea ice' and 'Ice shelves and icebergs'). Not only some general data related to the characteristics of various types of floating ice are described, but also some unique features such as polynyas, ice streams, and the

conditions beneath ice shelves. Some attention is paid to sea ice off eastern Asia, the Caspian and Aral Seas, and the ice-shelf topography. These tidbits are presented within frames (these occur also in other parts of the book).

The past and the present of the cryosphere are dealt with in Part III, which consists of Chapter 9 ('The cryosphere in the past') and Chapter 10 ('The future cryosphere: impacts of global warming'). There can be much discussion whether future effects of a higher temperature of the atmosphere - apart from the discussion about its causes - will be exceptional and different from what happened in the past, but global warming will undoubtedly interact with the development of our society. Earlier glaciations, from the Neoproterozoic glaciations until the Little Ice Age, are comprehensively described in terms of duration, extent and effects, and the characteristics of scenarios related to future variations in climate and cryosphere are also considered. Expected changes in the snow cover, inland ice, permafrost, fresh-water and sea ice of the northern hemisphere are presented, based on interactions with, and feedback from, the atmosphere, land, ocean and cryosphere. These are explained, on the basis of oscillation theory, in terms of large-scale climate anomalies.

Part IV (consisting of Chapter 11 only) deals with several important issues that are connected with the application of snow and ice research. It is mentioned that human interest is directed towards all phenomena described in the book, mainly because of the risks that they pose. It is interesting to read that winter sport and icy roads are not less responsible for tragedies than are snowfall, avalanches, fresh-water ice and icebergs.

The presentation of the book is certainly helpful in digesting its contents. The framed text blocks with some peculiarities from the world of nature, the extensive reference list, the notes at the end of each chapter, and a glossary make reading pleasant, but the clear handling of sometimes difficult issues is the main asset of the book. Ice ages, periods of global warming, periods of high aridity or moisture, etc., as well as all past, present and future environmental changes have in the past been reflected, are still being reflected and will, in the future, be reflected in the fragile image of the cryosphere, its reactions and its effects. The book is therefore recommended to all those dealing with theory and practice of cold-climate regions. For students and researchers alike, this modern compendium will certainly contribute to their knowledge.

Reference

Dobrowolski A.B., 1923. Historia naturalna lodu [The natural history of ice]. Kasa Pomocy im. Dr. J. Mianowskiego (Warsaw), 940 pp. (in Polish with French summary).

Grzegorz Rachlewicz
Institute of Geoecology and Geoinformation
Adam Mickiewicz University
Dziegielowa 27
61-680 Poznan
Poland
e-mail: grzera@amu.edu.pl