

BAMBER, J.L. and A.J. PAYNE, eds., 2004. *Mass balance of the cryosphere: observations and modelling of contemporary and future changes*, Foreword by John Houghton. Cambridge, etc., Cambridge University Press. 662 pp., 149 line diagrams, 3 half-tones, 16 tables, 33 colour figures. ISBN 0521808952, hardback, £85.

This is an edited volume containing 17 chapters divided into five parts: Observational Techniques and Methods; Modelling Techniques and Methods; The Mass Balance of Sea Ice; The Mass Balance of the Ice Sheets; and The Mass Balance of Ice Caps and Glaciers. There are in total around two dozen authors from Europe and North America. This book surveys the whole area of cryosphere mass balance. At 662 pages it is a substantial achievement, and if at its hardback price it is not for every researcher's bookshelf, most librarians should want to buy this book and all glaciological researchers will want and need access to it. I think the questions that prospective readers will want answered are: (i) is it comprehensive and up to date? (ii) is the level that of an undergraduate textbook or a review for researchers? (iii) are the articles of high quality? In addition, the publisher's summary on the back states that the book 'is fully integrated to provide a coherent, cross-referenced and consistent exposition on the subject', and readers will wish to know the extent to which this aim has been achieved. As might be expected, the answer to these questions varies from chapter to chapter. I thought that the negative points were few and far between and relatively minor, and it is more interesting and useful to focus on the positive features of the chapters: what is new, what is original and what cannot easily be found elsewhere.

The publisher's statement that the book has been written by the leading authors in their respective fields is absolutely correct. The author list contains a broad cross-section from the community. In general the articles are between 30 and 50 pages long, with the greatest variability being provided appropriately by the sea-ice authors.

The three chapters in Part I, 'In situ measurement techniques: land ice' (Hagen and Reeh), 'In situ measurement techniques: sea ice' (Wadhams) and 'Remote sensing measurement techniques' (Bamber and Kwok) are all nice summaries of the range of techniques available to measure the cryosphere. Hagen and Reeh are up to date with discussions of the coffee-can and GPR radargrams. The Bamber and Kwok chapter is an effective summary of the wide range of high-tech methods being used to monitor the cryosphere, as well as a discussion of what is about to come.

In Part II we find 'Modelling land ice surface mass balance' (Greuell and Genthon), 'Modelling land ice dynamics' (Van der Veen and Payne) and 'Modelling sea ice dynamics' (Hibler). Greuell and Genthon discuss a wide range of approaches to modelling glacier mass balance, from the semi-empirical parameterizations used at the local scale to the application of atmospheric GCMs. The chapter on ice-sheet modelling by Van der Veen and Payne contains a more detailed and highly readable evaluation of ice-sheet models that goes well beyond the recent textbook by the first author. Hibler's chapter is the longest in the book and probably the most technically demanding – certainly well above undergraduate level.

In Part III there is 'Sea ice observations' (Laxon, O. Johannessen, Miles, Wadhams and Walsh) and 'Sea-ice

modelling' (Flato). The chapter on observations is possibly a bit too short, but contains a good balance of non-satellite and satellite observations. Flato's chapter on sea-ice modelling is a more general and less technical survey than the chapter by Hibler.

Part IV contains 'Greenland: recent mass-balance observations' (Thomas and the PARCA investigators), 'Greenland: modelling' (Van der Wal), 'Mass balance of the Antarctic ice sheet: observational aspects' (Bentley) and 'Antarctica: modelling' (Huybrechts). The chapter by Thomas and others is a bang up-to-date and brisk survey of what is being done in Greenland at the moment. It is particularly well illustrated with colour diagrams. The emphasis in Van der Wal's modelling article is on meteorological processes, with good discussions of glaciological aspects such as ablation and refreezing. Bentley treats the Antarctic ice sheet using the accumulation/altimetry/flux-divergence trio of concepts, with some additional evidence regarding the long-term evolution of the West Antarctic ice sheet. Huybrechts discusses the application of the thermomechanically coupled ice-sheet models to Antarctica, with a useful emphasis on the response to Global Change.

In the final part, Part V, the smaller terrestrial ice masses are considered in 'Arctic ice caps and glaciers' (Dowdeswell), 'Glaciers and ice caps: historical background and strategies of worldwide monitoring' (Haeberli) and 'Glaciers and the study of climate and sea-level change' (Dyurgerov and Meier). All three chapters have a global perspective. Dowdeswell surveys the major Arctic ice caps and deals with particular technical issues associated with their monitoring; Haeberli considers the issues of how to measure the behaviour of large populations of small glaciers; and Dyurgerov and Meier provide a thorough survey of the wide range of techniques needed to consider the impact of changes in small glaciers on sea level.

The book contains more information and up-to-date knowledge than could possibly have been assembled by a single author or small group of authors. The problems one usually associates with edited volumes are not great. The diversity of style is, by and large, not off-putting and where there is overlap it is usually from considering the same subject areas from different perspectives, or in areas where there is more than one set of opinions widely held in the community. I think that glaciologists are used to addressing wide audiences, and this is reflected in the approachable writing styles found in most of the chapters. Some, though not all, chapters are extremely well illustrated and the publishers do not appear to have been parsimonious in permitting a good number of colour diagrams.

Physically, the book is up to the usual Cambridge University Press quality, well made and robust. It is attractively typeset, with readable and nicely set-out equations. It will be useful for everyone from third-year undergraduates onwards, containing concise, up-to-date reviews. I think this book will remain relevant and be used for a decade or more.

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