

## Review

ORLOVE, B., E. WIEGANDT and B.H. LUCKMAN, eds. 2008. *Darkening peaks: glacier retreat, science and society*. Berkeley, CA, University of California Press. 296pp. ISBN-10: 0-520253-05-1, ISBN-13: 978-0-520253-05-6, hardback, US\$45.

We now recognize that the Earth is warming – yet this is a subtle trend, buried in the noise of day-to-day and year-to-year variability. How can people not recognize this trend, when viewing the retreat of glaciers in the Swiss Alps, the depletion of the Snows of Kilimanjaro, or the disappearance of glaciers in Glacier National Park, Montana? Glacier retreat makes global warming visible, clearly and unequivocally. As stated in the overview chapter of this book, 'If the world does address the great challenge of global warming, it will be in part because of the way that glaciers serve as icons to make this challenge visible.'

Important as a visual icon and indicator of climate change, glacier retreat produces a host of problems for humankind, such as altered hydrologic regimens, loss of tourism values, effects on mining and agriculture, and changes to the global climate and water systems. This book is based on an International and Interdisciplinary Workshop on Mountain Glaciers and Society, held in Wengen, Switzerland, in October 2004. As such, it attempts to bring glacier science together with societal perceptions, impacts, and responses to these glacier changes. This is a laudable goal, and is completely in line with present-day attention to the human impacts of global change. Indeed, policy-makers as well as researchers need to put scientific results into a broader social, cultural and economic perspective in order to meet the challenges of a future Earth.

This book presents a rather restrictive view of this broad subject. The book discusses only small mountain glaciers in certain regions of temperate to tropical latitude, with concentration on the Swiss Alps. The large glaciers amidst the high peaks in southern Alaska (at the same latitude as the Norwegian glaciers) pose rather different challenges to society, including the production of sea-level rise and changes in nearshore ocean circulation and ecosystems, but are not mentioned. The glaciers of the mountainous arctic archipelagos affect Arctic Ocean freshwater balance, iceberg generation and perhaps sea-ice extent, a vital component to future climate change, as well as transportation and resource extraction, but these are not mentioned. Glacier surges and instability of tidewater glaciers may pose significant hazards, but are not mentioned. This volume therefore does not present a global view.

As one might expect from a workshop proceedings, the 20 different chapters vary from rather cursory descriptive reviews to a few incorporating new or recent quantitative, incisive results. A glaciologist will recognize naïveté (e.g. 'ice must reach a critical thickness before it can deform and move downslope' (p. 4); 'jökulhlaups are [primarily] caused by the outbreak of lakes from behind moraine dams' (p. 13)), as well as differing levels of sophistication ('the effect of glacier retreat on streamflow causes loss of runoff, or changes in seasonal runoff distribution, or loss of the natural regulation property of partly-glaciated basins' (various chapters)). Throughout, there is a pronounced Swiss bias even to the history of glaciology as a science, with no recognition

given to the great Icelandic, Norwegian, Swedish, English and Austrian naturalists of the 18th and early 19th centuries (together with the Swiss) who laid the foundation for our modern quantitative understanding of glaciers, nor to the geophysical approach that dominates in the 20th century.

Following an overview by the editors, chapters are grouped under 'Societal perceptions', 'Scientific observations', 'Trends in natural landscapes', 'Impacts on human landscapes' and 'Responses'. The first begins with an idiosyncratic view of the development of glacier research, ignoring the post-war interest by physicists and materials scientists and the impetus of the International Geophysical Year (July 1957/December 1958); the discussion of the role of the International Commission on Snow and Ice (now the International Association of Cryospheric Sciences) is not entirely correct, and some statements are outrageous, such as that science was set back ('a crisis' (p. 28)) by Nye's work on the physics of kinematic waves and by the oft-published figure showing the percent of glaciers advancing/retreating/stable. An interesting chapter discusses spiritual and social perceptions of Mount Shasta, California, but with only the most tenuous connection to glaciers. A chapter on glacier hazards describes four peculiar examples: Popocatepetl, Mexico; glacial-moraine lakes in the Cordillera Blanca, Peru; a glacier on Monte Rosa, Italy; and the rockfall/debris flow from the Kazbek massif, Russia. Fluctuations of glaciers in Norway are systematically reviewed. Another chapter presents a useful way to calculate mass balances for regions rather than just for individual glaciers, using the Alps as a test site. This is followed by a too brief but very interesting discussion of modeling the effect of global warming on the energy balance of glaciers in the dry central Andes, including changes in the areas subject to the growth of penitentes. A chapter on glacier mass balances in the North American Rockies mostly deals with tree-ring dating of moraines, but does bring in the importance of distinguishing winter from summer balances. Statistics on glaciers of the European Alps are presented which indicate that 38% of the ice area is comprised of glaciers <0.1 km<sup>2</sup> in area, and this is an underestimate. Thus the many national inventories that neglect the really small ice masses may be underestimating the hydrologic impact of glacier runoff.

Several sections discuss the disconnect, or even conflict, between planners/development authorities and the local citizenry in regard to glaciers, especially in the development of hydroelectric power and the minimization of natural hazards. These conflicts are well stated in discussions about Cotacachi, Ecuador, the Santa River Valley, Peru, (where thousands were killed in 1962 and 1970 by rockfall/debris flows off Huascarán) and Kyrgyzstan. The spiritual and aesthetic values of glaciers on high mountains are mentioned frequently; it is too bad that these values cannot be quantified.

Who should buy this book? Glowing reviews by well-known authors and scientists adorn the back cover, but I do not see that this book will have broad appeal. The smallest glaciers of the world mostly affect local areas – spiritually, aesthetically, hydrologically and as sources of local hazard. Larger glaciers affect the whole Earth system and, with that, a much larger segment of society. Glacier and ice-cap wastage could contribute as much as 24 cm to global-sea

level rise – as much as the Greenland ice sheet – in this century. This book is virtually silent about this problem. The good people of Bangladesh and the Pacific island nations, and many others, are very concerned.

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