

## **Darkening Peaks: Glacier Retreat, Science and Society**

*Edited by Ben Orlove, Ellen Weigandt and Brian Luckman. Berkeley: University of California Press, 2008. viii + 282 pp. US\$26.95. ISBN 978-0-520-25305-6.*

The glaciated mountains have evoked many responses in the hearts and minds of their human observers. Fear, and religious reverence remain today for many, and have been augmented, rather than supplanted by, modern scientific analysis. This book seeks to provide a synthesis of impacts caused by the oft-repeated assertion that glacier retreat is the clearest sign of on-going global warming, with severe consequences for humans. This is, to my knowledge, the first book with these ambitions, though it does not discuss the large ice sheets with their potentially catastrophic impact on sea levels. Instead, the focus is on the human relationship with glaciated mountains, and the book tackles this very well indeed.

The book originates in a workshop held in Switzerland in 2004. It is therefore not surprising that Alpine methods and subjects represent about a third of the chapters - though each and every chapter held new insights for me. But I found many of the other subject regions, such as the Andes, to be more interesting because the cultural and economic relationships between local peoples and glaciated mountains are so different and more intense than in the developed economies of Europe. However, the European setting is where much of the science of glaciology developed, and that is excellently presented in the book. Despite quite wide geographical coverage, there is a lack of information from the Himalaya or Asia, with only 1 chapter on Nepal, and nothing from

China or Russia. These are countries and regions in rapid transformation, with glaciers of tremendous local and global significance and where glaciology is an active field of research.

The introductory chapter will be required reading for my courses to all my students, from PhD-level modelers to inter-disciplinary Arts majors. It represents a rare example of synthesis between physical science and its cultural impact. The prose here, and in much of the rest of the book, is of considerably higher quality than in many edited volumes of science. I only noticed one typographical error in the book (Cotacachi is 4939m not 4039m high). In their introduction, the editors illustrate how glaciers form a cultural and literal backdrop, in tourist brochures, and in the soaring of the human spirit associated with their beauty. And of course the corollary, that the disappearance of glaciers - the literal darkening of the peaks - effects a diminution of the human spirit that recognizes the (eternally) faded glory that will be invisible to future generations. The authors strikingly suggest that the destruction of the Twin Towers caused distress not only because of the loss of life that occurred, but also because of their prominence in the global perceptions of man's built environment. The high peaks with their glittering glaciers play a similar role in the natural environment, and glacier disappearance exerts a similar emotional impact. In fact, I would go further. As shown in

the article by Rhoades et al. on the recent deglaciation of Cotacachi, Ecuador, local people are in denial: they continue to depict the mountain with a snow and glacier mantle, even though they see it has gone. They perhaps realize that that to remove the shining white covering represents a deep offence against Nature. This manifests itself in the globally widespread disbelief that humans could possibly cause such unprecedented change in the natural order of things, and a primeval fear that there will surely be a reckoning to come.

The book is divided into 5 sections. The first section discusses societal perceptions of glaciers, with chapters on the European Alps, and Switzerland in particular, to the fore; naturally reflecting historical documented evidence of the impact and importance of these glaciers to the local inhabitants. Haeberli shows that it is now clear that many of the Alpine glaciers are in rapid and, quite likely, terminal decline. Instead of leaving behind romantic vistas of forested mountain slopes and fertile fields, we will be faced with geomorphologically unstable slopes, as seen after the extreme summer of 2003. Other authors discuss legal and business frameworks for water rights, forestry, spring water, tourism, and risk assessment, with case studies from Mount Shasta (USA), Mexico, Peru, and North Ossetia.

Scientific observations are treated in part 2, with the first 3 chapters providing overviews of mass balance measurements by photographic records and field measurements, and reflecting the curiosity inherent in the development of glaciology from a series of tourist photographs through to the modern

science. Corripio et al. write about the dry Andes where glacier melt waters have importance to more than a million people for irrigation. The role of penitentes in glacier mass balance regimes, and how they change under climate shifts is intriguing. Their unusual geometry, resembling tall narrow spires, creates a slow ablation surface, in a warming climate they will migrate up-slope, temporarily enhancing summer water supply, as a simple snow melt surface forms - until the glacier reserves become exhausted.

Part 3 discusses trends in landscapes, which seems here to mean long-term change in glacier response to climate, illustrated for the Alps, the American Rockies and, most strikingly, Kilimanjaro. This work by Mölg et al fully encapsulates the spirit of the book's intentions in a single chapter which discusses field campaigns, atmospheric models, and societal impacts. Kilimanjaro is an icon for disappearing mountain glaciers: only 2.6 km<sup>2</sup> remain from 20 km<sup>2</sup> in 1880. However, it is the moisture fluctuations due to varying ENSO or Indian Ocean-atmosphere dynamics, rather than direct warming, that have caused the decline. Glaciers will likely disappear between 2020 and 2050, but seasonal snow will still occur in the wet season. In addition to large-scale circulation patterns, local deforestation is also reducing the trapping of fog moisture and reducing runoff for human use, as well as starving the glaciers.

Part 4 deals with impacts on human landscapes, with changes in mass tourism in New Zealand - along with greater hydro-power and reduced electricity consumption in warmer

winters - being positive outcomes expected from change. Exploitation of mineral wealth from beneath glaciers, or involving their destruction is typified by plans to move parts of glaciers in Peru to "geomorphologically similar" locations. That this was not done was not due to legislation, but to a dip in gold prices after 2001. However, mobilization of interested groups globally seems to have forced change to the idea which was not re-approved in 2004.

Part 5, entitled 'Responses' concerns the political factors that govern exploitation of glaciers: hydropower in Nepal, international relations in the former Soviet republics in Central Asia, and

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attempts at social reorganization as a response to glacier flood disasters in Peru provide a neat illustration of the broad factors spanned by the book.

Glaciers have taught two important lessons to society: that the Earth is dynamic and ancient; and that the Earth is sensitive and affected by humans. I found a new lesson in this book: the global response to ice sheet deglaciation and sea-level rise threat mirrors the response of local peoples everywhere when glaciers threaten their livelihoods: both rational and irrational, farsighted and blinkered.