

## **Mountain Ice and Water: Investigations of the Hydrologic Cycle in Alpine Environments**

Author: McDowell, Graham

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## Mountain Ice and Water: Investigations of the Hydrologic Cycle in Alpine Environments

Edited by Gregory B. Greenwood and John F. Shroder. Amsterdam, The Netherlands: Elsevier, 2016. xiv + 388 pp. Hardcover: US\$ 122.50, ISBN 978-0-444-63787-1. E-book: US\$ 122.50, ISBN 978-0-444-63788-8.

This volume features a diverse set of chapters that engage with both environmental and human dimensions of rapidly changing mountain systems. When compiling the volume, editors Greg Greenwood (former Executive Director of the Mountain Research Initiative) and Jack Shroder (Emeritus Professor of Geography and Geology at the University of Nebraska at Omaha) considered papers presented at the “Mountains of Our Future Earth” conference held in Perth, Scotland, in 2015. In particular, they endeavored to profile research from the conference that was well aligned with key Future Earth focal areas, namely, Dynamic Planet, Global Sustainable Development, and Transformations Towards Sustainability. The 9 chapters engage with a variety of geographies, issues, and methods, in several cases profiling regions, topics, and research approaches infrequently included in conversations about global change in mountain systems.

The Editorial Foreword briefly outlines the rationale and envisioned contributions of the book. Chapter 1 evaluates the role of Drakensberg Escarpment as a water supplier to South Africa, highlighting the disproportionate contribution of the escarpment to downstream water availability. Prudently, however, instead of focusing solely on climate-related threats to future water supply, the authors argue that downstream water stress is, and will continue to be, closely linked to the nexus of

changes in water supply, demand, and land management. They suggest that a holistic, transboundary water governance approach is required to navigate these socioecological complexities. Chapter 2 provides a fascinating assessment of the state of glaciers in Russia; it indicates that ice in the country’s 18 glacierized regions presently covers an area of 3,480,000 km<sup>2</sup>. The authors provide detailed information about the unique glacial environments, monitoring efforts, and research results for each glacierized region and ultimately determine that glaciers in Russia, of all system types, have generally been in decline over the last 100 years. This glaciology-focused chapter mentions but does not substantively evaluate downstream impacts.

Chapter 3 focuses on Potentially Harmful Trace Elements (PHTEs) in mountain waters. The authors discuss the sources, transport, and deposition of contaminants in mountain systems, introduce potential impacts on humans and other biota, and highlight the pressing need to know more about the interaction of PHTEs and other drivers of change in mountains (eg climate change). Chapter 4 weaves together insights from historical texts and archeological research to provide a rich history of continuity and change in the Lake Mývatn region of Iceland. After detailing the region’s hydrological, social, and ecological characteristics, the authors interrogate the emergence and consequences of silica mining activity, geothermal energy development, and increasing tourism. In addition to being a wonderful illustration of interdisciplinary research, the chapter convincingly illustrates how awareness of local history can aid the assessments of contemporary water (mis)management. Chapter 5 profiles a detailed study of mountain precipitation and conifer responses in the semiarid Great Basin region of the United States. The authors characterize microscale

ecohydrological phenomena across an elevation gradient over a four-year drought period. The study’s discovery of opportunistic responses of conifer species such as bristlecone pine (*Pinus longaeva*) to specific hydrometeorological events helps to advance understanding of the adaptability of conifers in semiarid mountain regions.

Chapter 6 evaluates the socioeconomic impact of recent hydropower developments on downstream communities in the Teetsa Basin of the eastern Indian Himalayas. The authors discuss effects on livelihoods, education, health, infrastructure, culture, and downstream environments, and they suggest that project impact assessments have not captured many consequential risks (and opportunities) associated with hydropower development. They argue that increased stakeholder engagement in impact assessments is needed to ensure that hydropower developments are more socially and environmentally sustainable. Chapter 7 investigates the effectiveness and distributional consequences of the Dhara Vikas program, a spring replenishment initiative that aimed to increase water availability for communities in the mountains of Sikkim, India. The authors argue that the water stress of highland populations has seen little improvement through the project; already better-off lowland populations benefited most. This outcome mirrors broader social stratifications and calls attention to the inherently social nature of vulnerability to environmental stress. Chapter 8 investigates the spiritual value of water in the Andes, shifting attention away from water as a provisioning service and toward water as a cultural service. The author, in his discussion of the role of mountain water in ritual and divination activities across various regions and cultural groups, argues that the nonmaterial value of water should be considered in conservation planning in the Andes. Chapter 9

presents the history and findings of Austria's long-term glacier monitoring network and profiles the monitoring of changes in glacier length, mass balance, area, volume, and runoff. The chapter also describes the characteristics of representative glacier monitoring strategies as it provides guidance for nascent monitoring efforts in other ranges.

*Mountain Ice and Water* embraces a forward-looking approach to the study of change in the mountain cryosphere and hydrosphere, reflecting its coherence with themes of the Mountains of Our Future Earth conference (see Gleeson et al 2016) and Future Earth more broadly. To this end, the book's inclusion of research by natural and social scientists, investigation of highly distinctive research topics, and profiling of diverse mountain systems will appeal to readers interested in the environmental and social complexities of changes in mountain watersheds.

Notwithstanding, the book has some shortcomings. First, there is no obvious logic to the order of the chapters, which makes the book read more like a collection of articles than a coherent volume. Second, this shortcoming is compounded by the lack of standalone Introduction and Conclusion chapters, which could

have provided a clearer metastructure for the book. The lack of such chapters also feels like a missed opportunity to signal the book's higher-level contributions and implications. Here reflections by the editors—both of whom are seasoned mountain researchers—would have been very interesting. Third, the included chapters are weighted toward the Dynamic Planet and Global Sustainable Development themes of Future Earth. The Transformations Towards Sustainability theme rarely comes up explicitly, although several chapters are suggestive of transformational changes in mountain environments, communities, and resource management regimes. However, this distribution of chapters is likely an artifact of the state of research rather than chapter selection bias. Finally, the title of the book does not signal the diversity of its content.

Unfortunately, this may mean that potentially interested readers may not seek out a highly interdisciplinary and timely book.

Despite these minor criticisms, the book represents a laudable and generally effective effort to advance understanding of mountain ice and water dynamics, sustainable mountain development, and transformative change within the

pages of one book, which complements other recent integrative texts on global change in mountain systems (eg Huggel et al 2015; Salzmann et al 2016). The book is appropriate for upper-level undergraduate students, graduate students, and research and planning professionals.

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#### AUTHOR

##### Graham McDowell

grahammcdowell@gmail.com  
Institute for Resources, Environment, and Sustainability, University of British Columbia, Vancouver, British Columbia V6T 1Z4, Canada

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