

## **Climate Driven Retreat of Mount Baker Glaciers and Changing Water Resources**

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## Climate Driven Retreat of Mount Baker Glaciers and Changing Water Resources

By Mauri Pelto. Cham, Switzerland: Springer, 2015. x + 107 pp. Softcover: US\$ 54.99, ISBN 978-3-319-22604-0. E-book: US\$ 39.99, ISBN 978-3-319-22605-7.

Recent high-profile papers have highlighted the importance and recent decline of small mountain glaciers (eg Radić and Hock 2011). Mountain glaciers are common in the Pacific Northwest, with the North Cascades of Washington State containing over 50% of the glaciers in the continental United States. Since 1900, the glacierized area in the region has nearly halved, with marked glacier recession over the last 40 years (McCabe and Fountain 2013). Such change has prompted wider-reaching concerns for this region, clearly emphasized by the recent US Department of Agriculture's "Climate Change Vulnerability and Adaptation" report (Raymond et al 2014). Consequently, this book, with its focus on the glaciology and associated hydrology of Mount Baker, to the northwest of the Cascades range, is an addition to the baseline data sets reporting contemporary change to Washington's frozen freshwater assets.

Pelto builds on existing data from the North Cascade Glacier Climate Project (NCGCP) and distills and synthesizes information focused on the glaciers surrounding Mount Baker. In particular, data from 2010 to 2014 are detailed, expanding on existing published materials for the region (eg Pelto and Hedlund 2001; Pelto 2006, 2008) and locality (eg Pelto and Brown 2012). As such, this book provides a real-world, highly visual overview of documented change recorded by the NCGCP team for a glacierized area of ~40 km<sup>2</sup> over a 31 year period. The book is divided into 6 chapters, which respectively

focus on the locality, recent glacier terminus response, glacier mass balance, glacial runoff, and brief descriptions of changes for 11 of the 15 named glaciers on Mount Baker. The order of these chapters is a logical progression, but perhaps in places the link from one to the next could have been made clearer. The text is readily accessible and well written in the main, and all chapters contain a huge volume of detail. Each section is remarkably rich in illustrative materials, which include graphical plots, maps, and repeat photographic imagery, all used to support concepts and ideas within the main text, as well as to exemplify observed glacier change and recession. Each chapter concludes with a short reference list, which is useful for directing further topical reading. Many of the examples presented are extended and detailed, and make interesting reading, although others (as well as some of the concepts or specifics) are somewhat brief and are not as fully or articulately developed as might have been expected.

Chapter 1 is informative in describing the Mount Baker setting, with particular attention drawn to the longer-term reductions in winter snow accumulation and rising summer air temperatures since 1946, coupled with larger-scale influences on local climate. Chapter 2 provides a synopsis of glacier response time to climate drivers, describing glacier fluctuations and their timescales over the last few centuries. In focusing on glacier mass balance, Chapter 3 centers on 1 of the Mount Baker glaciers and provides an overview of methods used to derive mass balance and gradients thereof, culminating in a comparison between Mount Baker and the wider North Cascades region. The glacier runoff for the locality is explored in Chapters 4 and 5, with particular focus on glacier-fed stream temperature variability, associations between discharge and glacier ablation, and the role such hydrological variability may have in

downstream ecosystems (specifically, salmonids) towards the Pacific Coast. The final part, Chapter 6, provides an inventory of the Mount Baker glaciers and describes each in turn alongside photographic evidence of change that highlights the marked recession of these ice masses in recent decades. The book's structure uses a methodical approach that ensures the reader is taken from the broader climatological picture through to the local glaciers' mass balance and then, understandably, on to runoff regimes and influences on freshwater ecosystems. However, the final section detailing individual glacier response seems somewhat misplaced, and the text tends towards description of glacier geometry, perhaps lacking the explicit focus on the climate drivers or resulting changes in water resources to which the book title alludes.

Given the complex interactions among climate, glaciers, and runoff, the topics in this book and its focus could readily extend far further, assuming data allowed for a wider examination of the causes and effects over the multidecadal timescale that NCGCP has run. However, that would be a different type of book. Here, Pelto has provided an accessible and informative perspective on glacier changes on Mount Baker with some remarkable details and visuals—and one that is accessible to a nonspecialist. Many facets of the science linking climate to glaciers and runoff are introduced, with chapters serving as case studies that include a wider literature and explore their subjects in language accessible to a broad readership. Pelto clearly demonstrates his experience and knowledge base for the locality, although some material is distilled to a brevity that perhaps leaves some segments a little weaker, dependent on inference, or subtly lacking in scientific clarity or elaboration. The more specialist reader might expect to consult the references cited, or turn to recent scientific publications in similar topic fields for the region

(eg Moore et al 2009; Grah and Beaulieu 2013; Cowie et al 2014; O'Neal et al 2015). One further frustrating element is the variability in quality and formatting of the significant volume of illustrative material, along with other subtle stylistic concerns—an observation that was surprising and tarnishes the clarity of the core messages being presented to a wide audience. Although some chapters provide a useful longer-term perspective on recent hydrometeorological changes, others seem to serve as “snapshots” of information, and as a consequence, sadly the book seems not entirely to deliver on the overarching promise that its title suggests.

Contemporary glacier responses to climate and changes in runoff are critical to our understanding of glacierized mountain systems, and clearly illustrating this with the apparent plethora of data available for Mount Baker via the NCGCP research program would seem to be the objective of this book. The material presented is reader-friendly, simplified yet thorough, well illustrated and informative, and it

provides a sound baseline of evidence for recent environmental change and contemporary regimes. Certainly, local glacier recession over the last few decades is observable and recounted emphatically here.

However, to borrow a phrase from another, it is unfair to focus too much on what the book is not. Rather, readers ranging from the inquisitive layperson to the professional glaciologist with an interest in the recent glaciology of the Mount Baker region will find informative material contained within this book.

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