

importance of place-names, traditional methods for navigation and predicting weather, and the necessity for certain tools (e.g., *qanikiurun*/snow shovel, *ayaruq*/walking stick, *egcik*/gaff) are a few of the topics discussed, in part to remind a younger generation of the dangers of travel, especially as the increasing use of technology, global positioning systems (GPS), and snow machines has made the wilderness more accessible.

The chapter focused on the ocean is unique with its emphasis that, unlike other aspects of the natural world, “the ocean cannot be learned” (p. 215). This is because the ocean is ever changing and highly responsive to human action and thought. While one may never understand the ocean, elders strongly caution that *qanruyutet* are of utmost importance for survival when traveling its “pitiless” waters (p. 219). A partial preview to this chapter can be found in a recent paper by Fienup-Riordan and Carmack (2011), entitled “‘The Ocean is Always Changing’: Nearshore and Farshore Perspectives on Arctic Coastal Seas.”

Readers seeking to learn about observations of recent environmental change in the Yukon-Kuskokwim Delta region must hold out for the final chapter, “The world is changing following its people.” Climate change is described as an “undercurrent of concern” throughout the elders’ discussions. Numerous observations are offered, such as food spoilage caused by warming temperatures, increased windiness, greater unpredictability in the weather, and sinking land due to permafrost melt. The authors emphasize that “Elders did not distinguish between various human impacts on the environment, including the effects of commercial fishing or overhunting, and the ‘natural’ effects of climate change. Instead elders continually referred to the role played by human action in the world when describing changes in the environment or species availability” (p. 42). The book ends with a powerful acceptance of responsibility from a people that are, ironically, immensely removed from the scientifically understood causes of climate change. The world, *ella*, is changing because people are no longer treating it with care and respect, and the Yupiit are no longer following the *qanruyutet*.

Throughout, the authors remain staunchly on track with delivering the documented verbal instructions and knowledge of Yup’ik elders. They sparingly and carefully weave in input from expert scientists to offer glimpses into efforts to better understand how local and traditional knowledge compares with scientific understandings. In the end, *Ellavut* leaves a clear impression that the Yup’ik worldview and knowledge base have resulted from a thin line being drawn between the seemingly practical and ordinary and the spiritual and extraordinary, all of which are equally important to remember when living a proper life. “Since they always gave instructions in the *qasgi*, my mother would tell me to go and listen, that the elderly men would talk about things I would never forget” (Simeon Agnus of Nightmute, July 2007, p. 164).

The single piece that I looked for in the book but did not find was the authors’ reflections on the process of working

with the CEC and producing the text. The only sections written in first person are the acknowledgments and the opening sentence: “On a blizzard March afternoon in 2008, Alice Rearden and I met with a dozen elders and young people gathered in the Chefnak community hall to document discussion on their way of life” (p. 3). The remainder of the book builds firmly on the conversations that took place in the Yup’ik language at this and many similar gatherings. *Ellavut* is a great example for the value of recording focused discussion at small gatherings, as opposed to the interview approach for documenting knowledge.

At a paperback price of US\$45, *Ellavut* is a tremendous value, not because of its attractive layout and careful organization, but for the impressive quantity of information distilled to its 354 pages, which include 3 maps and 68 photos and illustrations. It is not a book to read and pass on to others, but one to hold on to; it has lasting significance.

#### REFERENCE

- Fienup-Riordan, A., and Carmack, E. 2011. “The ocean is always changing”: Nearshore and farshore perspectives on Arctic coastal areas. *Oceanography* 24(3):266–279.

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- PERMAFROST HYDROLOGY. By MING-KO WOO. Berlin: Springer-Verlag, 2012. ISBN 978-3-642-23461-3. xii + 563 p., 442 colour and b&w figures, 20 tables, references, appendices, index. Hardbound. €249,00; US\$349.00.

Snow, ice, and frozen ground dominate the hydrological response of high-latitude catchments. Until resource development (~ 1970) initiated interest in the hydrological cycle of this sparsely populated region of the world, very little effort had been expended either to collect relevant data or to analyze the data collected. First, national hydrological and meteorological data networks were extended northward. Hydrologically oriented research studies that tried to quantify how snow, ice, and frozen ground may impact and alter the hydrology response of sub-Arctic and Arctic basins followed shortly. The net result was that we were very slow to gain an understanding of the hydrological cycle of cold regions.

Today, hydrological monitoring is still sparse, and most of the results of past research are found scattered around in scientific journals such as *Arctic*. Researchers have made occasional efforts to pull together results from numerous studies, such as the American Society of Civil Engineers monograph (1990) entitled *Cold Regions Hydrology and*

*Hydraulics* or the International Association of Hydrological Sciences publication (2004) *Northern Research Basins Water Balance*. However, while these and other publications were able to summarize some aspects of high-latitude hydrology, they were not able to capture a significant majority of the relevant hydrological processes. Clearly there was a niche to fill, with a work that updated our present understanding of high-latitude hydrology and captured all of the major mass and energy components of the hydrological cycle that were impacted by the snow, ice, and frozen ground in this region of the world. Finally, Ming-ko (“Hok”) Woo has produced a fairly comprehensive book entitled *Permafrost Hydrology*.

Permafrost is found in more than 20% of the extensive land area of the Northern Hemisphere, and most of it is in Canada and Russia. Because of the Antarctic ice sheet and maritime influence, the extent of permafrost in the Southern Hemisphere is limited primarily to the dry valleys of Antarctica (< 1%) and some high alpine regions. So this book by Hok Woo deals with hydrological applications for a fairly extensive area in the Northern Hemisphere with predominantly continental and Arctic climates.

The book has 10 chapters. A qualitative introductory chapter describes the setting for the world’s cold regions where continuous and discontinuous permafrost prevails. The following nine quantitative chapters cover the topics of Moisture and Heat, Groundwater, Snow Cover, Active Layer Dynamics, Slope Processes, Cold Lakes, Northern Wetlands, Rivers in Cold Regions, and Basin Hydrology. Mainly the author talks about the physical processes associated with these topics and presents examples drawn principally from his vast field experiences.

Phase change manifests itself in many ways in cold region hydrology and is active in many forms, such as snowmelt, transpiration, evaporation, sublimation, soil freezing and thawing, river and lake ice formation and decay, and aufeis development and melt. For example, the snowpack that accumulates for up to 8 to 10 months produces usually the highest runoff event of the year when it ablates. It is appropriate that these various phase-change processes are addressed rigorously in almost all of the chapters of this book; this focus is also reflected in the number of subject entries in the Index at the end of the book.

There are many ways to present so much comprehensive material, and one has to determine how to keep the material in the book presentable to the intended audience. I believe that the material in this book has been compiled in a very logical way. Except for the third chapter on groundwater, most of the chapters deal with hydrological processes very near the ground surface, such as snowpack, active layer, hill slopes, lakes, streams, and wetlands. The final chapter addresses the hydrological response of watersheds with different attributes, such as discontinuous permafrost, glaciers, topography, lakes, wetlands, and surface storage.

The author suggests that the audience could be professionals, non-professionals, and senior-level undergraduate students. I would add that this text could also be used

at the graduate level as reading material. For instructional purposes, however, it lacks both modeling examples and homework problems. A plethora of photographs and figures illustrate the book. Most are very informative, but a few images are poorly labeled: one cannot clearly identify in the picture what is described in the caption. In some cases (e.g., Figure 6.28a), the photos are too small; in others, (e.g., Figure 4.14), the quality of the picture is less than optimum. In the back of the book, there is a helpful glossary of technical terminology used in the hydrology profession. Figures and photographs throughout the book refer to specific field locations; to assist the reader, a table of place names and locations is provided in Appendix 3.

Each chapter is strongly supported by numerous citations. As should be expected, the citations are heavily weighted on the Canadian side and weakly reinforced on the Russian side. This simply demonstrates that there are few Russian publications that are originally in English-language journals or later translated from Russian to English. Presently we see warming of permafrost, thermokarst, deeper active layers, and other changes in response to climate change. At some point, climate warming will begin to have a significant impact on the hydrological response of watersheds underlain by permafrost; but this subject was not discussed at all in the book.

I would endorse the purchase of this book by a wide range of readers; it is general enough for non-professional hydrologists, but still has enough depth for the professionals. Although the book is a little pricey for students, I also believe that it is the best book available for a senior-level undergraduate or graduate level course on the hydrology of cold regions.

## REFERENCES

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- Ryan, W.L., and Crissman, R.D., eds. 1990. Cold regions hydrology and hydraulics. A State of the Practice Report prepared by the Technical Council on Cold Regions Engineering of ASCE. New York: American Society of Civil Engineers. 827 p.

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