PRINCIPLES OF SNOW HYDROLOGY

Snow hydrology is a specialized field of hydrology that is of particular importance for high latitudes and mountainous terrain. In many parts of the world, river and groundwater supplies for domestic, irrigation, industrial, and ecosystem needs are generated from snowmelt, and an in-depth understanding of snow hydrology is of clear importance. Study of the impacts of global warming has also stimulated interest in snow hydrology because increased air temperatures are projected to have major impacts on the snow hydrology of cold regions.

Principles of Snow Hydrology describes the factors that control the accumulation, melting, and runoff of water from seasonal snowpacks over the surface of the earth. The book addresses not only the basic principles governing snow in the hydrologic cycle, but also the latest applications of remote sensing, and principles applicable to modelling streamflow from snowmelt across large, mixed land-use river basins. Individual chapters are devoted to climatology and distribution of snow, ground-based measurements and remote sensing of snowpack characteristics, snowpack energy exchange, snow chemistry, modelling snowmelt runoff (including the SRM model developed by Rango and others), and principles of snowpack management on urban, agricultural, forest, and range lands. There are lists of terms, review questions, and problems with solutions for many chapters available online at www.cambridge.org/9780521823623.

This book is invaluable for all those needing an in-depth knowledge of snow hydrology. It is a reference book for practising water resources managers and a textbook for advanced hydrology and water resources courses which span fields such as engineering, Earth sciences, meteorology, biogeochemistry, forestry and range management, and water resources planning.

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Preface

This book is the culmination of several years of effort to create an up-to-date text book and reference book on snow hydrology. Our interest in snow hydrology was initiated while we were both taking an early snow hydrology class taught by Dr. James R. Meiman at Colorado State University. The book is an outgrowth of our interest in snow hydrology borne out of that class and later experiences while teaching snow hydrology courses of our own and conducting snow-related research. The book includes the basics of snow hydrology and updated information about remote sensing, blowing snow, soil frost, melt prediction, climate change, snow avalanches, and distributed modelling of snowmelt runoff, especially considering the effects of topography and forests. A separate chapter is devoted to the SRM or Snowmelt Runoff Model that Rango helped to develop, which includes the use of satellite snow-cover data. We have also added a chapter on management of snowpacks in rangeland, cropland, forest, alpine, and urban settings. Topics related to glaciology and glacial hydrology were largely avoided. The chapters are sequenced so that students with a basic understanding of hydrology and physics can progressively learn the principles of snow hydrology in a semester-long class. The book can serve as a text in an upper-level undergraduate or graduate-level class. We have included example computations in some of the chapters to enhance understanding. A website has been created for students with example problems and discussion questions related to specific chapters.

The authors are indebted to employers, colleagues, students, and family for making this book possible. Work began on the book during spring 2001 while DeWalle was on sabbatical leave from Penn State at USDA, Agricultural Research Service at Beltsville, MD. During summer 2001 the USDA ARS kindly provided support for Dr. DeWalle in Las Cruces, NM to continue this work. Over the intervening years many colleagues offered advice and comments on the various chapters, notably John Pomeroy (Chapter 2), Takeshi Ohta (Chapter 7), Martyn Tranter (Chapter 8), Doug Kane (Chapter 9), George Leavesley and Kevin Dressler (Chapter 10), and

James Meiman (Chapters 2, 3, and 12). Students in several of DeWalle's snow hydrology classes at Penn State also provided useful feedback. We appreciate the many helpful comments we have received, but in the final analysis we are responsible for any errors and mistakes. Penn State students Anthony Buda helped with literature searches, Brian Younkin helped prepare figures, and Sarah MacDougall helped with formatting the text. Staff at Penn State Institutes of the Environment, especially Sandy Beck, Chris Pfeiffer, and Patty Craig also provided valuable help. We are also very appreciative of the many people who kindly gave permissions to use figures, data, photos, etc. for the book. Finally, we are grateful to our families, especially spouses Nancy and Josie, for their support while this book writing project was underway.

Book Cover

Cover photo courtesy Dr. Randy Julander (United States Department of Agriculture, Natural Resources Conservation Service) showing Upper Stillwater Dam on Rock Creek, tributary to the Duchesne River and then Green River, on the south slope of the Uintah Mountains near Tabiona, Utah.