

Handbook of
Engineering
Hydrology

Environmental Hydrology
and Water Management

Handbook of Engineering Hydrology

Handbook of Engineering Hydrology: Fundamentals and Applications, Book I

Handbook of Engineering Hydrology: Modeling, Climate Change, and Variability, Book II

Handbook of Engineering Hydrology: Environmental Hydrology and Water Management, Book III

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and Water Management

Edited by
Saeid Eslamian



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Preface

Hydrological and ecological connectivity is a matter of high concern. All terrestrial and coastal ecosystems are connected with water, which includes groundwater, and there is a growing understanding that “single ecosystems” (mountain forest, hill forest, mangrove forest, freshwater swamp, peat swamp, tidal mudflat, and coral reef) that are actually the result of an artificial perception and classification can, in the long term, only be managed by a holistic vision at the watershed level. It is essential to investigate ecosystem management at the watershed level, particularly in a changing climate.

In general, there are two important approaches:

1. Adaption to hydrological events such as climate change, drought, and flood
2. Qualitative and quantitative conservation of water, thereby optimizing water consumption

The *Handbook of Engineering Hydrology* aims to fill the two-decade gap since the publication of David Maidment’s *Handbook of Hydrology* in 1993 by including updated material on hydrology science and engineering. It provides an extensive coverage of hydrological engineering, science, and technology and includes novel topics that were developed in the last two decades. This handbook is not a replacement for Maidment’s work, but as mentioned, it focuses on innovation and provides updated information in the field of hydrology. Therefore, it could be considered as a complementary text to Maidment’s work, providing practical guidelines to the reader. Further, this book covers different aspects of hydrology using a new approach, whereas Maidment’s work dealt principally with classical components of hydrologic cycle, particularly surface and groundwater and the associated physical and chemical pollution.

The key benefits of the book are as follows: (a) it introduces various aspects of hydrological engineering, science, and technology for students pursuing different levels of studies; (b) it is an efficient tool helping practitioners to design water projects optimally; (c) it serves as a guide for policy makers to make appropriate decisions on the subject; (d) it is a robust reference book for researchers, both in universities and in research institutes; and (e) it provides up-to-date information in the field.

Engineers from disciplines such as civil engineering, environmental engineering, geological engineering, agricultural engineering, water resources engineering, natural resources, applied geography, environmental health and sanitation, etc., will find this handbook useful.

Further, courses such as engineering hydrology, groundwater hydrology, rangeland hydrology, arid zone hydrology, surface water hydrology, applied hydrology, general hydrology, water resources engineering, water resources management, water resources development, water resources systems and planning, multipurpose uses of water resources, environmental engineering, flood design, hydrometeorology, evapotranspiration, water quality, etc., can also use this handbook as part of their curriculum.

This set consists of 87 chapters divided into three books, with each book comprising 29 chapters. This handbook consists of three books as follows:

1. Book I: Fundamentals and Applications
2. Book II: Modeling, Climate Change, and Variability
3. Book III: Environmental Hydrology and Water Management

This book focuses on environmental hydrology and water management. The chapters can be categorized as follows:

- *Groundwater management*: Anthropogenic Aquifer: A New Thinking, Artificial Recharge Experiences in Semiarid Areas, Groundwater Vulnerability, and Hydrofracturing and Environmental Problems.
- *Purification, sanitation, and quality modeling*: Disinfection of Water and Nanotechnology, Environmental Engineering for Water and Sanitation Systems, Environmental Nanotechnology, Modeling of Wetland Systems, Nonpoint Source and Water Quality Modeling, Water Pollution Control Using Low-Cost Natural Wastes, and Water Supply and Public Health and Safety.
- *Surface water management*: Environmental Flows, River Managed System for Flood Defense, Stormwater Modeling and Management, Stormwater Modeling and Sustainable Management in Highly Urbanized Areas, Tourism and River Environmental Hydrology, and Transboundary River Basin Management.
- *Wastewater and sediment management*: Historical Development of Wastewater Management, Sediment Pollution, and Sustainable Wastewater Treatment.
- *Water law*: Water Governance, Water Scarcity, and Water Security: Concept, Measurement, and Operationalization.
- *Water resources management*: Formation of Ecological Risk on Plain Reservoirs, Modification in Hydrological Cycle, Sustainable Development in Integrated Water Resources Management, Transboundary Water Resource Management, Updating the Hydrological Knowledge: A Case Study, and Water Resources Assessment in a River using AVSWAT Model.

About 200 authors from various departments and across more than 30 countries worldwide have contributed to this book, which includes authors from the United States comprising about one-third of the total number. The countries that the authors belong to have diverse climate and have encountered issues related to climate change and water deficit. The authors themselves cover a wide age group and are experts in their fields. This book could only be realized due to the participation of universities, institutions, industries, private companies, research centers, governmental commissions, and academies.

I thank several scientists for their encouragement in compiling this book: Prof. Richard McCuen from the University of Maryland, Prof. Majid Hassanizadeh from Utrecht University, Prof. Soroush Sorooshian from the University of California at Irvine, Profs. Jose Salas and Pierre Julien from Colorado State University, Prof. Colin Green from Middlesex University, Prof. Larry W. Mays from Arizona State University, Prof. Reza Khanbilvardi from the City College of New York, Prof. Maciej Zalewski from the University of Łódź'-Poland, and Prof. Philip B. Bedient from Rice University.

In addition, Research Professor Emeritus Richard H. French from Las Vegas Desert Research Institute, who has authored the book *Open Channel Hydraulics* (McGraw-Hill, 1985), has encouraged me a lot. I quote his kind words to end this preface:

My initial reaction to your book is simply WOW!

Your authors are all well known and respected and the list of subjects very comprehensive. It will be a wonderful book. Congratulations on this achievement.

Saeid Eslamian

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Editor



Saeid Eslamian is an associate professor of hydrology at Isfahan University of Technology, Iran, where he heads the Hydrology Research Group at the Department of Water Engineering. His research focuses mainly on statistical and environmental hydrology and climate change. In particular, he specializes in modeling and prediction of natural hazards including floods, droughts, storms, wind frequency, and groundwater drawdowns, as well as pollution in arid and semiarid zones, particularly in urban areas.

Prof. Eslamian was born in Isfahan, a large city located in the center of Iran. He received his BS in water engineering from Isfahan University of Technology in 1986. Later, he was offered a scholarship for a master's degree at Tarbiat Modares University, Tehran. He completed his studies in hydrology and water resources in 1989. In 1991, he was awarded a grant for pursuing his PhD in civil engineering at the University of New South Wales, Sydney, Australia. His supervisor was Professor David H. Pilgrim, who encouraged him to conduct research on regional flood frequency analysis using a new region of influence approach. Soon after his graduation in 1995, Eslamian returned to Iran and worked as an assistant professor at Isfahan University of Technology (IUT). In 2001, he was promoted to associate professor.

Eslamian was a visiting professor at Princeton University, Princeton, New Jersey, in 2006 and at the University of ETH Zurich, Switzerland in 2008. During this period, he developed multivariate L-moments for low flow and soil-moisture interaction.

Eslamian has contributed to more than 300 publications in books, research journals, and technical reports or papers in conferences. He is the founder and chief editor of the *International Journal of Hydrology Science and Technology* and the *Journal of Flood Engineering*. He also serves as an editorial board member and reviewer of about 30 Web of Science (ISI) journals. Recently, he has been appointed as the chief editor for a three-set book series Handbook of Engineering Hydrology by Taylor & Francis Group (CRC Press).

Prof. Eslamian has prepared course material on fluid mechanics, hydraulics, small dams, hydraulic structures, surface runoff hydrology, engineering hydrology, groundwater hydrology, water resource management, water resource planning and economics, meteorology, and climatology at the undergraduate level and material on evapotranspiration and water consumption, open channel hydraulics, water resources engineering, multipurpose operation of water resources, urban hydrology, advanced hydrology, arid zones hydrology, rangeland hydrology, groundwater management, water resources development, and hydrometeorology at the graduate level.

He has presented courses on transportation, Energy and Agriculture Ministry; and different university departments in governmental and private sectors: civil engineering, irrigation engineering, water engineering, soil sciences, natural resources, applied geography, and environmental health and sanitation.

Eslamian has undertaken national and international grants on “Studying the impact of global warming on the Kingdom of Jordan using GIS,” “Study of the impact of different risk levels of climate change on Zayandehroud River Basin’s climatic variables,” “Feasibility of reclaimed water reuse for industrial uses in Isfahan Oil Refining Company,” “Microclimate zoning of Isfahan city and investigation of microclimate effect on air temperature, relative humidity and reference crop evapotranspiration,” “Feasibility of using constructed wetland for urban wastewater,” “Multivariate linear moments for low flow analysis of the rivers in the north-eastern USA,” and “Assessment of potential contaminant of landfill on Isfahan water resources.” He has received two ASCE and EWRI awards from the United States in 2009 and 2010, respectively, as well as an outstanding researcher award from Iran in 2013. Persian being his native language, Prof. Eslamian is also fluent in English and is professionally familiar with French and Arabic.

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