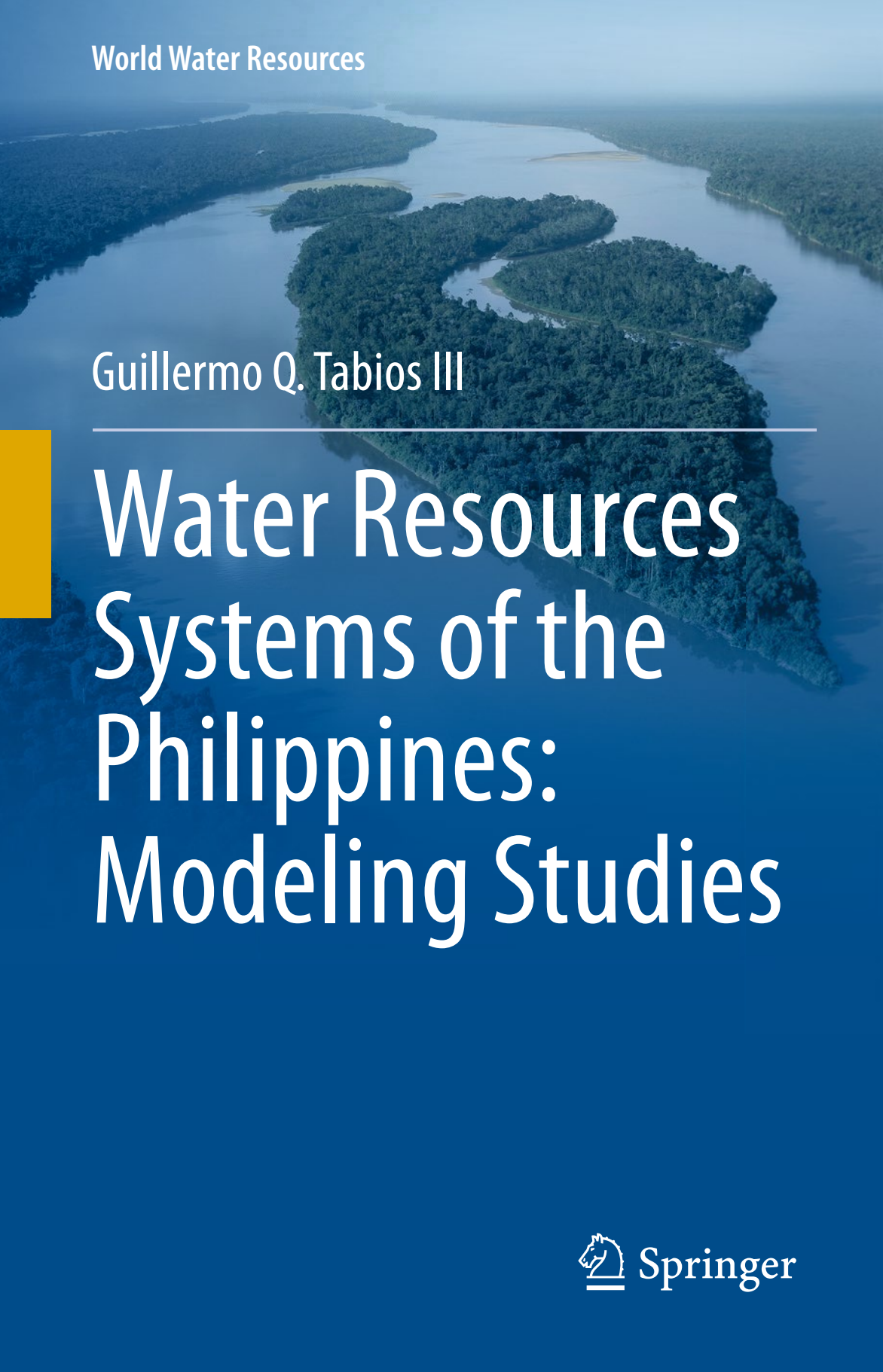
World Water Resources
Guillermo Q. Tabios III
Water Resources Systems of the Philippines: Modeling Studies
Springer

World Water Resources

Volume 4

Series Editor
V. P. Singh, Department of Biological and Agricultural Engineering & Zachry Department of Civil Engineering, Texas A&M University, College Station, TX, USA

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To my papa, Nono, and mama, Nida, who kindly nurtured me
and
to my wife, Aida, and daughter, Gillian, who endearingly bring out the best in me

Preface

Modeling of water resources systems is essential to develop science-based information, policies, and management actions for effective water resources planning design and operations. Models have been utilized for descriptive and prescriptive purposes such as understanding the behavior of the water resources system; evaluation of strategies to restore, enhance, maintain, or control the integrity of the water resource; detection and surveillance for water resources regulation; as well as forecasting for real-time operations or prediction for possible future behavior of the water resources systems. These days, water resources models and modeling tools have become more sophisticated since one must not only consider the physical and ecological component of the water resources system but also its interaction with the socioeconomic and human systems. In linking science and public policy toward an effective integrated water resources management (IWRM), the decision support system (DSS) which essentially evolves around models and modeling tools is an integral part of IWRM process as a platform or vehicle to link science and technology advances to public policy and management decisions. Water resources planners, managers, and other specialists who are responsible for the development and operation of water resources systems as well as stakeholders can use the DSS in understanding, articulating, and building *a shared vision* of how the water resources system functions; how to evaluate feasible, alternative management options including their impacts or consequences; and finally how to develop consensus for its sustainable development and utilization.

In the Philippines, modeling of water resources systems for planning, design, and management is not quite a common practice especially in government agencies involved in managing the country's water resources. One of the reasons is that the Philippines still lacks investments in science-based management and decision tools. Most water-related agencies in the Philippines do not have a dedicated scientific division in their offices to employ science-based analysis or modeling tools although some agencies employ consultants to conduct water resources modeling but on project basis. Having a permanent modeling group will ensure continuous updating and adaptive master planning and operational studies of water resources system

because watersheds or natural resources systems in general are evolutionary in nature due to land use change, anthropogenic activities, economic change, and climate change. Another challenge is that the country lacks investments in sustained and regular monitoring of water-related data. Thus, model development can be hardly calibrated against the observed data so that the art of modeling plays a significant role to judiciously use experience, knowledge, and insights into the physics of the process and, to some extent, imagination to validate and qualify the results of the modeling studies.

This book presents several modeling experiences and studies of water resources systems of the Philippines and advocates the use of modeling tools to ensure science-based, policy formulations and management decisions in water resources planning and management. The suite of water resources modeling studies includes surface and groundwater modeling for water utilization, reservoir planning and operations studies with optimization-simulation models, reservoir sedimentation studies, hydrodynamic and water quality modeling of bays and lakes, flood and dambreak modeling studies, pipe network distribution modeling with optimization, climate change studies for reliability of reservoir operations, and modeling for environmental assessment studies. The storylines of the motivation and/or purpose of the various modeling studies conducted are also presented for certain water resources systems studied.

Several models used here are available as public domain models and were designed with various optional methods that can be used for hydrologic, hydraulic, and water quality analysis. These public domain models require familiarity and hands-on experience; thus, using these models is more of an art rather than purely the science of modeling. Some models used here were also developed by the author himself and, in certain cases, with collaborators. For these latter models, the author is not only proficient in using them but also very much familiar with the theoretical basis, structure, and algorithms of these models.

The book is intended for professionals, practitioners, as well as undergraduate and graduate students to learn the art and science of modeling water resources systems, in general, and water resources systems of the Philippines, in particular. As the book contains details of model structures and solution algorithms, the various models can likewise be utilized to other water resources systems one wishes to study. With the unique settings and conditions of the Philippines with humid, maritime, tropical climatology and hydrology, as well as with its archipelagic or islandic watersheds typified by short, steep mountain-to-coast river systems, this book offers different perspectives and experiences in modeling these types of water resources systems.

Quezon City, Philippines Guillermo Q. Tabios III

Acknowledgments

The author was a graduate student at Colorado State University (CSU) in Fort Collins at the onset of 1980, and the development of water resources models highly proliferated because personal computers (especially the iconic IBM-PC) became available right at graduate student room's desktop. Thus, doing computer work became quicker from developing, testing, and debugging computer programs, instead of the routine of going to the computer center, with decks of cards, and the turnaround time of computer jobs is several hours or a day later. The author was fortunate to be in that era, and in fact, there was a saying then that "anyone who knows how to write Fortran programs those days can finish a PhD in no time." Evidently so, many hydrologic and hydraulic computer programs were developed during that period, and until now, they still remain as the heart of major water resources computer software, significantly enhanced only with nice graphical user interfaces.

Being a PhD graduate student then at CSU, the author was exposed to several schools of thought with regard to his modeling know-how and experiences. In particular, his major influences came from his PhD adviser, Prof. Jose D. Salas, on stochastic analysis and modeling of hydrologic processes; Prof. Warren A. Hall, his initial PhD adviser on optimization and simulation models of water resources systems; and some members of his PhD guidance committee, specifically Prof. Hubert J. Morel-Seytoux on deterministic hydrology and Prof. Vujica Yevjevich on stochastic hydrology. After graduate school, he worked with Prof. Hsieh Wen Shen as postdoctoral fellow at CSU and later as research faculty at the University of California, Berkeley, on river and reservoir sediment transport processes as well as ecology-based river engineering by physical and mathematical modeling.

For the many projects and modeling works conducted at the National Hydraulic Research Center (NHRC) of the University of the Philippines at Diliman (UPD), especially those presented in this book, the author gratefully acknowledges several people that include David S. Rojas, Jr., Odyssey C. Herrera, Edmundo P. Vargas, Eugene C. Herrera, Abner M. Adraneda, Arlene B. Inocencio, Proserfina A. Mariano, Cornelio Q. Dizon, Peter Paul M. Castro, and Genandrialine L. Peralta.

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