Stochastic Methods in Subsurface Contaminant Hydrology

Edited by Rao S. Govindaraju



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Abstract: *Stochastic Methods in Subsurface Contaminant Hydrology* is a compilation of existing methodologies and emerging techniques that are available for performing stochastic analysis of contaminant transport through porous media. Analytical tools, such as perturbation methods, spectral analysis, spatial and temporal moments, cumulant expansions, streamtube approaches, decomposition methods, and Kalman filtering, are covered in various chapters of the book. Concepts of reactive and nonreactive transport, dilution, anomalous dispersion, and others are illustrated through examples from field and laboratory experiments and from simulation exercises.

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Preface

Currently, there are several schools of thought for analyzing contaminant transport problems in porous media. This book focuses on stochastic techniques that are used to address the spatial heterogeneity of flow and transport parameters that exists in most field cases. Apart from a preliminary chapter, this book contains nine chapters written by researchers representing the various schools of thought. Some of the methods of analysis covered here include: perturbation methods, Green's functions, moment analysis, cumulant expansion methods, decomposition principles, and Kalman filtering approaches. Both Eulerian and Lagrangian viewpoints are represented. Diverse topics such as reactive and nonreactive transport, stochastic streamtube modeling, multicomponent systems, dilution and dispersion, and anomalous dispersion have been discussed in the book. References to field studies, laboratory experiments, and simulation results have been provided at appropriate locations in the text.

This book includes elementary and advanced topics to appeal to a wide audience. Readers are expected to have a basic understanding of stochastic processes. The book is intended for students, researchers, and academicians interested in subsurface contaminant transport problems. It will also be useful for practitioners who are interested in these topics and would like to learn more about existing and emerging techniques in this area. This book will serve as an important reference to people interested in hydrology, environmental problems, soil physics, geologists, applied mathematics, and, particularly, proponents of stochastic methods.

Editing this book proved to be an educational experience. While going through the various chapters, I came across different viewpoints and diverse ideas expressed by the authors. This effort has broadened my understanding and appreciation of the subject. For this, I thank all the contributors without whom this book would not be possible. I have covered some of the topics with my students. Much of the material is relevant to a course on Advanced Subsurface Hydrology that is offered in the School of Civil Engineering at Purdue University, and I suspect, similar courses elsewhere. I

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expect this book to play an important role in my future teaching endeavors, and hope that others will find it useful as well.

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I am grateful to the authors for undertaking the task of preparing the various chapters in this book. Over a span of several years, they have patiently prepared their chapters, responded to reviewers' comments, and answered my numerous queries.

All the chapters were reviewed independently before being sent to the publisher. In addition, ASCE conducted independent reviews of the book in its entirety. I would like to acknowledge the help of all the reviewers for their efforts to improve the quality of the chapters. The help of Joy E. Chau, Acquisitions Editor with ASCE Press, is noted for expediting the review process, and for taking care of administrative matters at the ASCE office.

Here at Purdue University, I benefited from many discussions with my colleagues. In particular, I would like to acknowledge the immediate faculty in the Environmental and Hydraulic Engineering Area—Professors A.R. Rao, D.A. Lyn, and J.W. Delleur—for their encouragement and support. Several students assisted in this effort by letting me 'try out' various versions on them. Among these, T.P. Chan, L. Kalin, N. Nahar, K.V. Nedunuri, and B. Zang deserve mention.

The process of converting all the chapters into a unified format was a particularly challenging task during the preparation of this book. In this matter, the assistance of Ms. Dinah Hackerd is greatly appreciated. Her secretarial expertise and typing skills proved invaluable throughout this endeavor.

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