

Preface

Environmental Modeling and Health Risk Analysis (ACTS/RISK)

The purpose of this book is to provide the reader with an integrated perspective on several fields. First, it discusses the fields of environmental modeling in general and multimedia (the term “multimedia” is used throughout the text to indicate that environmental transformation and transport processes are discussed in association with three environmental media: air, groundwater and surface water pathways) environmental transformation and transport processes in particular; it also provides a detailed description of numerous mechanistic models that are used in these fields. Second, this book presents a review of the topics of exposure and health risk analysis. The Analytical Contaminant Transport Analysis System (ACTS) and Health RISK Analysis (RISK) software tools are an integral part of the book and provide computational platforms for all the models discussed herein. The most recent versions of these two software tools can be downloaded from the publisher’s web site. The author recommends registering the software on the web download page so that users can receive updates about newer versions of the software.

This book is intended to support instruction in environmental quality modeling in surface water, air and groundwater pathways that are linked to exposure and health risk analysis. The book is based on the author’s many years of experience in field applications as well as in classroom teaching on these topics. As such, it should serve as a valuable tool and reference for practicing professionals as well as for graduate and undergraduate students. It is currently used as a textbook in the School of Civil and Environmental Engineering at the Georgia Institute of Technology in a senior-level undergraduate class that frequently includes graduate students.

Studies on environmental quality modeling can be traced back to G.I. Taylor’s seminal work on diffusion processes in 1921. Since then, the scientific field of the analysis of advection, diffusion and dispersion processes has experienced considerable progress with the introduction of many innovative concepts, principles and applications. Now, in what may be identified as the field of air and water quality modeling, there are numerous models which make use of these principles in

providing solutions to complex problems. There are a number of excellent textbooks which are available on air, groundwater and surface water quality modeling, and they are cited throughout the book. However, this book differs from others in that its first purpose is to provide an integrated view of basic principles of environmental quality modeling in these seemingly different media, as well as a comprehensive review of the analytical models that are available in these fields. The reader will recognize that the basic principles and modeling tools described in each chapter for air, groundwater and surface water pathways are very similar, at least in mathematical form. This is because both air and water are fluids, so the transport and transformation processes in each medium are governed by similar processes that mathematically follow the same principles. The author hopes that practicing professionals and students who are interested in these topics will find this integrated approach useful.

During the past decade, exposure and health risk analysis has also become an important and inseparable part of environmental assessment. This is primarily because we, as scientists and engineers, are no longer only interested in environmental characterization, remediation and management, but we are also interested in health effects or ecosystem hazards associated with pollutants which are present in the environment or released into the environment. Similarly, numerous models for exposure and health risk analysis have been developed in the literature as well, and it is the second purpose of this book to provide an integrated view of these topics and link them to environmental transformation and transport models.

The models discussed in this book have been coded for easy access and use in ACTS and RISK. These two software tools have been developed as WINDOWSTM based applications to provide professionals in environmental engineering and environmental health with a compact resource for the analytical methods discussed in this text. These models can be used to evaluate the transport and transformation of contaminants in multimedia environments (air, surface water, soil and groundwater) as well as to perform exposure and health risk analysis. The multimedia transport and transformation models included in this software and reviewed in this book are state-of-the-art analytic tools that can be used in the analysis of steady state and time dependent contaminant transformation and transport processes. For the analysis of cases that may involve uncertainty in input parameters, Monte Carlo methods have been developed and are dynamically linked with all pathway models included in the ACTS and RISK software. In the Monte Carlo analysis mode, all or a selected subset of input parameters of a particular model may be characterized in terms of statistical distributions provided in the software, allowing statistical distributions of contaminant concentrations or exposure risk to be evaluated at a particular exposure point at a particular point in time.

Currently, the total number of environmental transformation and transport and exposure models that are included in the ACTS and RISK software exceeds 300 (when all subcategory models for each pathway are considered). These models may be used to evaluate and understand how chemical and pathway specific properties of the media impact the transformation and transport and the overall exposure and health risk assessment processes. In addition to serving as a documentation of the technical background of the models used in the ACTS and RISK software, the book also serves as the reference document for these software tools.



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