Dynamics Of Environmental Bioprocesses Modelling And Simulation

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Modelling Environmental Dynamics Springer Science & Business Media
The steady increase in industrialization, urbanization and enormous population growth are leading to production of huge quantities of wastewaters that may frequently cause environmental hazards. This makes waste water treatment and waste water reduction very important issues. The book offers a collection of studies and findings concerning waste water treatment, minimization and reuse.
Analysis of Ecological Systems: State-of-the-Art in Ecological Modelling Springer Science & Business Media
Many biologists and ecologists have developed models that find widespread use in theoretical investigations and in applications to organism behavior, disease control, population and metapopulation theory, ecosystem dynamics, and environmental management. This book captures and extends the process of model development by concentrating on the dynamic aspects of these processes and by providing the tools such that virtually anyone with basic knowledge in the Life Sciences can develop meaningful dynamic models. Examples of the systems modeled in the book range from models of cell development, the beating heart, the growth and spread of insects, spatial competition and extinction, to the spread and control of epidemics, including the conditions for the development of chaos. Key features: - easy-to-learn and easy-to-use software - examples from many subdisciplines of biology, covering models of cells, organisms, populations, and metapopulations - no prior computer or programming experience required Key benefits: - learn how to develop modeling skills and system thinking on your own rather than use models developed by others - be able to easily run models under alternative assumptions and investigate the implications of these assumptions for the dynamics of the biological system being modeled - develop skills to assess the dynamics of biological systems
Environmental Modelling Taylor & Francis
This book demonstrates how mathematical models constructed in system dynamics modelling platforms, such as Vensim, can be used for long-term management of environmental change. It is divided into two sections, with the first dedicated to theory, where the theory of co-evolutionary modelling and its use in the system dynamics model platform is developed. The book takes readers through the steps in the modelling process, different validation tools applicable to these types of models and different growth specification, as well as how to curve fit using numerical methods in Vensim. Section 2 comprises of a collection of applied case studies, including fisheries, game theory and wildlife management. The book concludes with lessons from the use of co-evolutionary models for long-term natural resource management. The book will be of great interest to students and scholars of environmental economics, natural resource management, system dynamics, ecological modelling and bioeconomics.
Modeling the Environment Springer
Modeling techniques that allow managers and researchers to see in advance the consequences of actions and policies are becoming increasingly important to environmental management. Modeling the Environment is a basic introduction to one of the most widely known and used modeling techniques, system dynamics. Modeling the Environment requires little or no mathematical background and is appropriate for undergraduate environmental students as well as professionals new to modeling.
Chemical Engineering Dynamics John Wiley & Sons
The International Society for Ecological Modelling (ISEM) sponsors conferences, workshops and training courses with the aim of advancing the development of ecological and environmental modelling. The 3rd International Conference on the state-of-the-art in ecological modelling was sponsored by the ISEM in cooperation with the National Park Service Water Resources Laboratory and hosted by the Natural Resource Ecology Laboratory at Colorado State University. Its theme was the application of ecological modelling to environmental management and this book contains the full texts of the three invited papers presented in the five general sessions, plus the final summaries and syntheses of the topics covered during those sessions.
Mathematical Models and Environmental Change BoD – Books on Demand
This volume brings together, in a central text, chapters written by leading scholars working at the intersection of modeling, the natural and social sciences, and public participation. This book presents the current state of knowledge regarding the theory and practice of engaging stakeholders in environmental modeling for decision-making, and includes basic theoretical considerations, an overview of methods and tools available, and case study examples of these principles and methods in practice. Although there has been a significant increase in research and development regarding participatory modeling, a unifying text that provides an overview of the different methodologies available to scholars and a systematic review of case study applications has been largely unavailable. This edited volume seeks to address a gap in the literature and provide a primer that addresses the growing demand to adopt and apply a range of modeling methods that includes the public in environmental assessment and management. The book is divided into two main sections. The first part of the book covers basic considerations for including stakeholders in the modeling process and its intersection with the theory and practice of public participation in environmental decision-making. The second part of the book is devoted to specific applications and products of the various methods available through case study examination. This second part of the book also provides insight from several international experts currently working in the field about their approaches, types of interactions with stakeholders, models produced, and the challenges they perceived based on their practical experiences.
Fundamentals of Ecological Modelling Springer Science & Business Media
Foremost multinational contributors discuss the scientific achievements of environmental modelling, evaluate its limits and identify the restrictions these might place on predicting the effects of environmental change. Includes new techniques and approaches that might be successfully applied to environmental problems.
Modeling the Environment, Second Edition Springer Science & Business Media
State-of-the-Art in Ecological Modelling covers the proceedings of the Conference on Ecological Modeling, held in Copenhagen, Denmark from August 28 to September 2, 1978. The book focuses on ecological modeling, particularly prey-predator models, lake and river models, toxic substances models, and holistic approaches to ecological modeling. The selection first discusses review presentations of ecological modeling, including river models, prey-predator models, application of graphical methods, and lake models. The application of microcosms in ecological modeling; water quality and irrigation in agriculture models; and distribution and effect of toxic substances models are also elaborated. The text then takes a look at the models of sea and coastal areas, atmospheric pollution, ecosystems in the lithosphere, and water management. The book surveys multi-species of planktons and nutrients model of lake eutrophication and modeling of vertical temperature distribution and its implication on biological processes in lakes. Topics include mathematical expression of multi-species of planktons and nutrients model in lake ecosystem; observation data on water quality and planktons; and models for vertical temperature distribution. The selection is a dependable reference for readers wanting to dig deeper into ecological modeling.
Environmental Modeling Springer Science & Business Media
Fundamentals of Ecological Modelling: Applications in Environmental Management and Research, Fourth Edition, provides a comprehensive discussion of the fundamental principles of ecological modeling. The first two editions of this book (published in 1986 and 1994) focused on the roots of the discipline the four main model types that dominated the field 30-40 years ago: (1) dynamic biogeochemical models; (2) population dynamic models; (3) ecotoxicological models; and (4) steady-state biogeochemical and energy models. The third edition focused on the mathematical formulations of ecological processes that are included in ecological models. This fourth edition uses the four model types previously listed as the foundation and expands the latest model developments in spatial models, structural dynamic models, and individual-based models. As these seven types of models are very different and require different considerations in the model development phase, a separate chapter is devoted to the development of each of the model types. Throughout the text, the examples given from the literature emphasize the application of models for environmental management and research. - Presents the most commonly used model types with a step-by-step outline of the modeling procedure used for each - Shows readers through an illustrated example of how to use each model in research and management settings - New edition is revised to include only essential theory with a focus on applications - Includes case studies, illustrations, and exercises (case study of an ecological problem with full illustration on how to solve the problem)
Chemodynamics and Environmental Modeling John Wiley & Sons
The book gives a comprehensive overview of all available types of ecological models. It is the first book of its kind that gives an overview of different model types and will be of interest to all those involved in ecological and environmental modelling and ecological informatics.
Environmental Modeling with Stakeholders Elsevier
Addressing the basic concepts of ecological modelling, Jorgensen provides the user with a tool which can assist in the understanding of what various model types/network calculations can do, as well as outlining when to use which type as a tool to solve a specific problem.
Dynamic Modeling of Environmental Systems CRC Press
This is a thoroughly revised and updated edition of an authoritative introduction to ecological modelling. Sven Erik Jørgensen, Editor-in-Chief of the journal Ecological Modelling, and Giuseppe Bendoricchio, Professor of Environmental Modelling at the University of Padova, Italy, offer compelling insights into the subject. This volume explains the concepts and processes involved in ecological modelling, presents the latest developments in the field and provides readers with the tools to construct their own models. The Third Edition features:• A detailed discussion and step-by-step outline of the modelling procedure.• An account of different model types including overview tables, examples and illustrations.• A comprehensive presentation of the submodels and unit processes used in modelling. • In-depth descriptions of the latest modelling techniques.• Structured exercises at the end of each chapter. • Three mathematical appendices and a subject index.This practical and proven book very effectively combines the theory, methodology and applications of ecological modelling. The new edition is an essential, up-to-date guide to a rapidly growing field.
Modelling Complex Ecological Dynamics WIT Press
Mathematical modelling is an essential tool in present-day ecological research. Yet for many ecologists it is still problematic to apply modelling in their research. In our experience, the major problem is at the conceptual level: proper understanding of what a model is, how ecological relations can be translated consistently into mathematical equations, how models are solved, steady states calculated and interpreted. Many textbooks jump over these conceptual hurdles to dive into detailed formulations or the mathematics of solution. This book attempts to fill that gap. It introduces essential concepts for mathematical modelling, explains the mathematics behind the methods, and helps readers to implement models and obtain hands-on

experience. Throughout the book, emphasis is laid on how to translate ecological questions into interpretable models in a practical way. The book aims to be an introductory textbook at the undergraduate-graduate level, but will also be useful to seduce experienced ecologists into the world of modelling. The range of ecological models treated is wide, from Lotka-Volterra type of principle-seeking models to environmental or ecosystem models, and including matrix models, lattice models and sequential decision models. All chapters contain a concise introduction into the theory, worked-out examples and exercises. All examples are implemented in the open-source package R, thus taking away problems of software availability for use of the book. All code used in the book is available on a dedicated website.

Introduction to Environmental Modeling Springer Science & Business Media

With descriptions of hundreds of the most important environmental and ecological models, this handbook is a unique and practical reference source. The Handbook of Environmental and Ecological Modeling is ideal for those working in environmental modeling, including regulators and managers who wish to understand the models used to make assessments. Overviews of more than 360 models are easily accessed in this handbook, allowing readers to quickly locate information they need about models available in a given ecosystem. The material in the Handbook of Environmental and Ecological Modeling is logically arranged according to ecosystem. Each of the sixteen chapters of the handbook covers a particular ecosystem, and includes not only the descriptions of the models, but also an overview of the state-of-the-art in modeling for that particular ecosystem. A summary of the spectrum of available models is also provided in each chapter. The extensive table of contents and the easy-to-use index put materials immediately at your fingertips.

Water Pollution Issues and Developments Springer

Microbial communities are a critical component of natural ecosystems and industrial bioprocesses. In natural ecosystems, these communities can present abrupt and surprising responses to perturbations, which can have important consequences. For example, climate change can influence drastically the composition of microbial communities in the oceans, which in turn affects the entirety of the food chain, and changes in diet can affect drastically the composition of the human gut microbiome, making it stronger or more vulnerable to infection by pathogens. In industrial bioprocesses, engineers work with these communities to obtain desirable products such as biofuels, pharmaceuticals, and alcoholic beverages, or to achieve relevant environmental objectives such as wastewater treatment or carbon capture. Mathematical models of microbial communities are critical for the study of natural ecosystems and for the design and control of bioprocesses. Good mathematical models of microbial communities allow scientists to predict how robust an ecosystem is, how perturbed ecosystems can be remediated, how sensitive an ecosystem is with respect to specific perturbations, and in what ways and how fast it would react to environmental changes. Good mathematical models allow engineers to design better bioprocesses and control them to produce high-quality products that meet tight specifications. Despite the importance of microbial communities, mathematical models describing their behavior remain simplistic and only applicable to very simple and controlled bioprocesses. Therefore, the study of natural ecosystems and the design of complex bioprocesses is very challenging. As a result, the design of bioprocesses remains experiment-based, which is slow, expensive, and labor-intensive. With high throughput experiments large datasets are generated, but without reliable mathematical models critical links between the species in the community are often missed. The design of novel bioprocesses rely on informed guesses by scientists that can only be tested experimentally. The expenses incurred by these experiments can be difficult to justify. Predictive mathematical models of microbial communities can provide insights about the possible outcomes of novel bioprocesses and guide the experimental design, resulting in cheaper and faster bioprocess development. Most mathematical models describing microbial communities do not take into account the internal structure of the microorganisms. In recent years, new knowledge of the internal structures of these microorganisms has been generated using highthroughput DNA sequencing. Flux balance analysis (FBA) is a modeling framework that incorporates this new information into mathematical models of microbial communities. With FBA, growth and exchange flux predictions are made by solving linear programs (LPs) that are constructed based on the metabolic networks of the microorganisms. FBA can be combined with the mathematical models of dynamical biosystems, resulting in dynamic FBA (DFBA) models. DFBA models are difficult to simulate, sensitivity information is challenging to obtain, and reliable strategies to solve optimization problems with DFBA models embedded are lacking. Therefore, the use of DFBA models in science and industry remains very limited. This thesis makes DFBA simulation more accessible to scientists and engineers with DFBAlab, a fast, reliable, and efficient Matlab-based DFBA simulator. This simulator is used by more than a 100 academic users to simulate various processes such as chronic wound biofilms, gas fermentation in bubble column bioreactors, and beta-carotene production in microalgae. Also, novel combinations of microbial communities in raceway ponds have been studied. The performance of algal-yeast cocultures and more complex communities for biolipids production has been evaluated, gaining relevant insights that will soon be tested experimentally. These combinations could enable the production of lipids-rich biomass in locations far away from power plants and other concentrated CO 2 sources by utilizing lignocellulosic waste instead. Following reliable DFBA simulation, the mathematical theory required for sensitivity analysis of DFBA models, which happen to be nonsmooth, was developed. Methods to compute generalized derivative information for special compositions of functions, hierarchical LPs, and DFBA models were generated. Significant numerical challenges appeared during the sensitivity computation of DFBA models, some of which were resolved. Despite the challenges, sensitivity information for DFBA models was used to solve for the steady-state of a high-fidelity model of a bubble column bioreactor using nonsmooth equation-solving algorithms. Finally, local optimization strategies for different classes of problems with DFBA models embedded were generated. The classes of problems considered include parameter estimation and optimal batch, continuous steady-state, and continuous cyclic steady-state process design. These strategies were illustrated using toy metabolic networks as well as genome-scale metabolic networks. These optimization problems demonstrate the superior performance of optimizers when reliable sensitivity information is used, as opposed to approximate information obtained from finite differences. Future work includes the development of global optimization strategies, as well as increasing the robustness of the computation of sensitivities of DFBA models. Nevertheless, the application of DFBA models of microbial communities for the study of natural ecosystems and bioprocess design and control is closer to reality.

Dynamical Modelling & Estimation in Wastewater Treatment Processes CRC Press

Simulation models are increasingly used to investigate processes and solve practical problems in a wide variety of disciplines eg. climatology, ecology, hydrology, geomorphology, engineering. Environmental Modelling: A Practical Approach addresses the development, testing and application of such models, which apply across traditional boundaries, and demonstrate how interactions across these boundaries can be beneficial. Provides a general overview of methods and approaches as well as focusing on key subject areas written by leading practitioners in the field Assesses the advantages and disadvantages of different models used and provides case studies supported with data, output, tutorial exercises and links to the model and/or model applications via the book's website Covers major developments in the field, eg. the use of GIS and remote sensing techniques, and scaling issues As associated website contains colour images, as well as links to www resources

Modeling Dynamic Biological Systems WIT Press

Partitioning of chemicals in the environment and its modeling is becoming an important field in environmental science and engineering. This book enables students, researchers, and interested laymen to enter the field of environmental modeling in a fast and effective way. The book contains modeling software (CemoS V 1.10), data sets and the CemoS handbook. Each chapter contains examples and exercises.

Spatiotemporal Environmental Health Modelling: A Tractatus Stochasticus John Wiley & Sons

Spatiotemporal Environmental Health Modelling: A Tractatus Stochasticus provides a holistic, conceptual and quantitative framework for Environmental Health Modelling in space-time. The holistic framework integrates two aspects of Environmental Health Science that have been previously treated separately: the environmental aspect, which involves the natural processes that bring about human exposure to harmful substances; and the health aspect, which focuses on the interactions of these substances with the human body. Some of the fundamental issues addressed in this work include variability, scale, uncertainty, and space-time connectivity. These topics are important in the characterization of natural systems and health processes. Spatiotemporal Environmental Health Modelling: A Tractatus Stochasticus explains why modern stochastics is the appropriate mechanical vehicle for addressing such issues in a rigorous way. In particular, modern stochastics incorporates concepts and methods from probability, classical statistics, geostatistics, statistical mechanics and field theory. The authors present a synthetic view of environmental health that embraces all of the various components and focuses on their mutual interactions. Spatiotemporal Environmental Health Modeling: A Tractatus Stochasticus includes new material on Bayesian maximum entropy estimation techniques and space-time random field estimation methods. The authors show why these methods have clear advantages over the classical geostatistical estimation procedures and how they can be used to provide accurate space-time maps of environmental health processes. Also included are expositions of diagrammatic perturbation and renormalization group analysis, which have not been previously discussed within the context of Environmental Health. Finally, the authors present stochastic indicators that can be used for large-scale characterization of contamination and investigations of health effects at the microscopic level. This book will be a useful reference to both researchers and practitioners of Environmental Health Sciences. It will appeal specifically to environmental engineers, geographers, geostatisticians, earth scientists, toxicologists, epidemiologists, pharmacologists, applied mathematicians, physicists and biologists.

Environmental Modelling Elsevier

Dynamic environmental processes are complex; the easiest and most effective way to understanding them lies through the disciplines of dynamic modelling and computer simulation. The prerequisite modelling fundamentals are presented in the first chapter in a manner comprehensible to students as well as to practising scientists and engineers. The second chapter describes the many environmental processes that lend themselves to modelling, for example pollution and wastewater treatment. The third part of the book provides 65 simulation examples both on the page and on an accompanying diskette in the simulation language ISIM - the first time that this has been done with a teaching book in this field - ready-to-run on any DOS personal computer. Crucially, the simulation runs can be interrupted to allow rapid interactive parameter changes and easy plotting of results; this enables the reader to get a feel for the model and system behaviour.

Simulation, Sensitivity Analysis, and Optimization of Bioprocesses Using Dynamic Flux Balance Analysis Routledge

In this book the authors consider the natural environment as an integrated system. The physical, chemical and biological processes that govern the behaviour of the environmental system can thus be understood through mathematical modelling, and their evolution can be studied by means of numerical simulation. The book contains a summary of various efficient approaches in atmospheric prediction, such as numerical weather prediction and statistical forecast of climate change, as well as other successful methods in land surface modelling. The authors explore new theories and methods in environment prediction such as systems analysis and information theory. Attention is given to new achievements in remote sensing tele-metering and geographic information systems.