

Machine Learning For Spatial Environmental Data Theory Applications And Software Environmental Sciences Environmental Engineering

This book focuses on the theory and application of interdependent networks. The contributors consider the influential networks including power and energy networks, transportation networks, and social networks. The first part of the book provides the next generation sustainability framework as well as a comprehensive introduction of smart cities with special emphasis on energy, communication, data analytics and transportation. The second part offers solutions to performance and security challenges of developing interdependent networks in terms of networked control systems, scalable computation platforms, and dynamic social networks. The third part examines the role of electric vehicles in the future of sustainable interdependent networks. The fourth and last part of this volume addresses the promises of control and management techniques for the future power grids.

GIS and Environmental Modeling: Progress and Research Issues Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks, Carol Johnston, David Maidment, Michael Crane, and Sandi Glendinning, Editors With growing pressure on natural resources and landscapes there is an increasing need to predict the consequences of any changes to the environment. Modelling plays an important role in this by helping our understanding of the environment and by forecasting likely impacts. In recent years moves have been made to link models to

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Geographical Information Systems to provide a means of analysing changes over an area as well as over time. GIS and Environmental Modeling explores the progress made to date in integrating these two software systems. Approaches to the subject are made from theoretical, technical as well as data stand points. The existing capabilities of current systems are described along with important issues of data availability, accuracy and error. Various case studies illustrate this and highlight the common concepts and issues that exist between researchers in different environmental fields. The future needs and prospects for integrating GIS and environmental models are also explored with developments in both data handling and modelling discussed. The book brings together the knowledge and experience of over 100 researchers from academic, commercial and government backgrounds who work in a wide range of disciplines. The themes followed in the text provide a fund of knowledge and guidance for those involved in environmental modelling and GIS. The book is easily accessible for readers with a basic GIS knowledge and the ideas and results of the research are clearly illustrated with both colour and black and white graphics.

Computers in Earth and Environmental Sciences: Artificial Intelligence and Advanced Technologies in Hazards and Risk Management addresses the need for a comprehensive book that focuses on multi-hazard assessments, natural and manmade hazards, and risk management using new methods and technologies that employ GIS, artificial intelligence, spatial modeling, machine learning tools and meta-heuristic techniques. The book is clearly organized into four parts that cover natural hazards, environmental hazards, advanced tools and technologies in risk management, and future challenges in computer applications to hazards and risk management. Researchers and professionals in Earth and Environmental

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Science who require the latest technologies and advances in hazards, remote sensing, geosciences, spatial modeling and machine learning will find this book to be an invaluable source of information on the latest tools and technologies available. Covers advanced tools and technologies in risk management of hazards in both the Earth and Environmental Sciences Details the benefits and applications of various technologies to assist researchers in choosing the most appropriate techniques for purpose Expansively covers specific future challenges in the use of computers in Earth and Environmental Science Includes case studies that detail the applications of the discussed technologies down to individual hazards Machine Learning for Spatial Environmental Data Theory, Applications, and Software CRC Press

This handbook covers a wide range of topics related to the collection, processing, analysis, and use of geospatial data in their various forms. This handbook provides an overview of how spatial computing technologies for big data can be organized and implemented to solve real-world problems. Diverse subdomains ranging from indoor mapping and navigation over trajectory computing to earth observation from space, are also present in this handbook. It combines fundamental contributions focusing on spatio-textual analysis, uncertain databases, and spatial statistics with application examples such as road network detection or colocation detection using GPUs. In summary, this handbook gives an essential introduction and overview of the rich field of spatial information science and big geospatial data. It introduces three different perspectives, which together define the field of big geospatial data: a societal, governmental, and governance perspective. It discusses questions of how the acquisition, distribution and exploitation of big geospatial data must be organized both on the scale of

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companies and countries. A second perspective is a theory-oriented set of contributions on arbitrary spatial data with contributions introducing into the exciting field of spatial statistics or into uncertain databases. A third perspective is taking a very practical perspective to big geospatial data, ranging from chapters that describe how big geospatial data infrastructures can be implemented and how specific applications can be implemented on top of big geospatial data. This would include for example, research in historic map data, road network extraction, damage estimation from remote sensing imagery, or the analysis of spatio-textual collections and social media. This multi-disciplinary approach makes the book unique. This handbook can be used as a reference for undergraduate students, graduate students and researchers focused on big geospatial data. Professionals can use this book, as well as practitioners facing big collections of geospatial data.

This book is related to various applications of laser scanning in landslide assessment. Landslide detection approaches, susceptibility, hazard, vulnerability assessment and various modeling techniques are presented. Optimization of landslide conditioning parameters and use of heuristic, statistical, data mining approaches, their advantages and their relationship with landslide risk assessment are discussed in detail. The book contains scanning data in tropical forests; its indicators, assessment, modeling and implementation. Additionally, debris flow modeling and analysis including source of debris flow identification and rockfall hazard assessment are also presented.

Precipitation drives the dynamics of flows and storages in water systems, making its monitoring essential for water management. Conventionally, precipitation is monitored using in-situ and remote sensors. In-situ sensors are arranged in networks, which are usually sparse,

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providing continuous observations for long periods at fixed points in space, and due to the high costs of such networks, they are often sub-optimal. To increase the efficiency of the monitoring networks, we explore the use of sensors that can relocate as rainfall events develop (dynamic sensors), as well as increasing the number of sensors involving volunteers (citizens). This research focusses on the development of an approach for merging heterogeneous observations in non-stationary precipitation fields, exploring the interactions between different definitions of optimality for the design of sensor networks, as well as development of algorithms for the optimal scheduling of dynamic sensors. This study was carried out in three different case studies, including Bacchiglione River (Italy), Don River (U.K.) and Brue Catchment (U.K.) The results of this study indicate that optimal use of dynamic sensors may be useful for monitoring precipitation to support water management and flow forecasting.

Optical Remote Sensing is one of the main technologies used in sea surface monitoring. Optical Remote Sensing of Ocean Hydrodynamics investigates and demonstrates capabilities of optical remote sensing technology for enhanced observations and detection of ocean environments. It provides extensive knowledge of physical principles and capabilities of optical observations of the oceans at high spatial resolution, 1-4m, and on the observations of surface wave hydrodynamic processes. It also describes the implementation of spectral-statistical and fusion algorithms for analyses of multispectral optical databases and establishes physics-based criteria for detection of complex wave phenomena and hydrodynamic disturbances including assessment and management of optical databases. This book explains the physical principles of high-resolution optical imagery of the ocean surface, discusses for the first time the capabilities of observing hydrodynamic processes and events, and emphasizes the

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Integration of optical measurements and enhanced data analysis. It also covers both the assessment and the interpretation of dynamic multispectral optical databases and includes applications for advanced studies and nonacoustic detection. This book is an invaluable resource for researchers, industry professionals, engineers, and students working on cross-disciplinary problems in ocean hydrodynamics, optical remote sensing of the ocean and sea surface remote sensing. Readers in the fields of geosciences and remote sensing, applied physics, oceanography, satellite observation technology, and optical engineering will learn the theory and practice of optical interactions with the ocean.

This book introduces the latest research findings in cloud, edge, fog, and mist computing and their applications in various fields using geospatial data. It solves a number of problems of cloud computing and big data, such as scheduling, security issues using different techniques, which researchers from industry and academia have been attempting to solve in virtual environments. Some of these problems are of an intractable nature and so efficient technologies like fog, edge and mist computing play an important role in addressing these issues. By exploring emerging advances in cloud computing and big data analytics and their engineering applications, the book enables researchers to understand the mechanisms needed to implement cloud, edge, fog, and mist computing in their own endeavours, and motivates them to examine their own research findings and developments.

The book introduces the latest methods and algorithms developed in machine and deep learning (hybrid symbolic-numeric computations, robust statistical techniques for

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clustering and eliminating data as well as convolutional neural networks) dealing not only with images and the use of computers, but also their applications to visualization tasks generalized by up-to-date points of view. Associated algorithms are deposited on iCloud.

Sustaining ecosystems to deliver what people need and value, while mitigating and adapting to global climate change and extreme event impacts, presents a complex set of environmental, economic, and social challenges in ensuring resilient and sustainable food production. The Climate Smart Landscape (CSL) approach has emerged as an integrated management strategy to address the increasing pressures on agricultural production, ecosystem conservation, rural livelihoods, climate change mitigation and adaptation. Deploying cheaper, more accurate, and efficient technology enables the harnessing of big data for use in solving sustainability challenges. With improved integrated analytical frameworks, statistical approaches, spatially- explicit models and indices, the CSL approach can be further developed and applied for more resilient, productive, and sustainable ecosystems. This eBook brings together original research, review, hypothesis, theory, and technology report articles, involving 87 authors from 9 countries across Asia, Europe, and North America. These articles present new methodological and technological innovation, findings, and insights across four themes: (1) landscape productivity and crop suitability, (2) variable crop requirements for water and nutrients, (3) crop health status, phenology, and phenotyping, and (4) crop disease

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assessment and prediction under integrated pest management (IPM).

This book combines geostatistics and global mapping systems to present an up-to-the-minute study of environmental data. Featuring numerous case studies, the reference covers model dependent (geostatistics) and data driven (machine learning algorithms) analysis techniques such as risk mapping, conditional stochastic simulations, descriptions of spatial uncertainty and variability, artificial neural networks (ANN) for spatial data, Bayesian maximum entropy (BME), and more.

Analysis and Modelling of Spatial Environmental Data presents traditional geostatistics methods for variography and spatial predictions, approaches to conditional stochastic simulation and local probability distribution function estimation, and select aspects of Geographical Information Systems. It includes real case studies using Geostat Office software tools under MS Windows and also provides tools and methods to solve problems in prediction, characterization, optimization, and density estimation. The author describes fundamental methodological aspects of the analysis and modelling of spatially distributed data and the application by way of a specific and user-friendly software, GSO Geostat Office. Presenting complete coverage of geostatistics and machine learning algorithms, the book explores the relationships and complementary nature of both approaches and illustrates them with environmental and pollution data. The book includes introductory chapters on machine learning, artificial neural networks of different architectures, and support vector machines algorithms. Several chapters

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cover monitoring network analysis, artificial neural networks, support vector machines, and simulations. The book demonstrates the promising results of the application of SVM to environmental and pollution data.

Exploring real case studies using Geostat Office software tools under MS Windows, this authoritative reference includes chapters on monitoring network analysis, artificial neural networks, support vector machines, and simulations. The book also provides tools and methods to solve challenges in prediction, characterization, optimization, and density estimation, and presents the following key information: * traditional geostatistics methods for variography and spatial predictions * approaches to conditional stochastic simulation and local probability distribution function estimation * select aspects of Geographical Information Systems.

A state-of-the-art presentation of optimum spatio-temporal sampling design - bridging classic ideas with modern statistical modeling concepts and the latest computational methods. Spatio-temporal Design presents a comprehensive state-of-the-art presentation combining both classical and modern treatments of network design and planning for spatial and spatio-temporal data acquisition. A common problem set is interwoven throughout the chapters, providing various perspectives to illustrate a complete insight to the problem at hand. Motivated by the high demand for statistical analysis of data that takes spatial and spatio-temporal information into account, this book incorporates ideas from the areas of time series, spatial statistics and stochastic

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processes, and combines them to discuss optimum spatio-temporal sampling design. Spatio-temporal Design: Advances in Efficient Data Acquisition: Provides an up-to-date account of how to collect space-time data for monitoring, with a focus on statistical aspects and the latest computational methods. Discusses basic methods and distinguishes between design and model-based approaches to collecting space-time data. Features model-based frequentist design for univariate and multivariate geostatistics, and second-phase spatial sampling. Integrates common data examples and case studies throughout the book in order to demonstrate the different approaches and their integration. Includes real data sets, data generating mechanisms and simulation scenarios. Accompanied by a supporting website featuring R code.

Spatio-temporal Design presents an excellent book for graduate level students as well as a valuable reference for researchers and practitioners in the fields of applied mathematics, engineering, and the environmental and health sciences.

This book contains peer-reviewed papers from the Second World Landslide Forum, organised by the International Consortium on Landslides (ICL), that took place in September 2011. The entire material from the conference has been split into seven volumes, this one is the seventh: 1. Landslide Inventory and Susceptibility and Hazard Zoning, 2. Early Warning, Instrumentation and Monitoring, 3. Spatial Analysis and Modelling, 4. Global Environmental Change, 5. Complex Environment, 6. Risk Assessment, Management and Mitigation, 7. Social and Economic Impact and Policies.

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Predictive Soil Mapping (PSM) is based on applying statistical and/or machine learning techniques to fit models for the purpose of producing spatial and/or spatiotemporal predictions of soil variables i.e. maps of soil properties and classes at different resolutions. It is a multidisciplinary field combining statistics, data science, soil science, physical geography, remote sensing, geoinformation science and a number of other sciences. Predictive Soil Mapping with R is about understanding the main concepts behind soil mapping, mastering R packages that can be used to produce high quality soil maps, and about optimizing all processes involved so that also the production costs can be reduced. The online version of the book is available at: <https://envirometrix.github.io/PredictiveSoilMapping/>

Pull requests and general comments are welcome. These materials are based on technical tutorials initially developed by the ISRIC's Global Soil Information Facilities (GSIF) development team over the period 2014-2017

Since the emergence of contemporary area classifications, population geography has witnessed a renaissance in the area of policy related spatial analysis. Area classifications subsume geodemographic systems which often use data mining techniques and machine learning algorithms to simplify large and complex bodies of information about people and the places in which they live, work and undertake other social activities. Outputs developed from the grouping of small geographical areas on the basis of multi- dimensional data have proved beneficial particularly for decision-

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making in the commercial sectors of a vast number of countries in the northern hemisphere. This book argues that small area classifications offer countries in the Global South a distinct opportunity to address human population policy related challenges in novel ways using area-based initiatives and evidence-based methods. This book exposes researchers, practitioners, and students to small area segmentation techniques for understanding, interpreting, and visualizing the configuration, dynamics, and correlates of development policy challenges at small spatial scales. It presents strategic and operational responses to these challenges in cost effective ways. Using two developing countries as case studies, the book connects new transdisciplinary ways of thinking about social and spatial inequalities from a scientific perspective with GIS and Data Science. This offers all stakeholders a framework for engaging in practical dialogue on development policy within urban and rural settings, based on real-world examples. Features: The first book to address the huge potential of small area segmentation for sustainable development, combining explanations of concepts, a range of techniques, and current applications. Includes case studies focused on core challenges that confront developing countries and provides thorough analytical appraisal of issues that resonate with audiences from the Global South. Combines GIS and machine learning methods for studying interrelated disciplines such as Demography, Urban Science, Sociology, Statistics, Sustainable Development and Public Policy. Uses a multi-method approach and analytical techniques of primary and

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secondary data. Embraces a balanced, chronological, and well sequenced presentation of information, which is very practical for readers.

The year 2005 sparked a geographic revolution through the release of Google Maps, arguably the first geographic tool to capture public interest and act as a catalyst for neogeography (i.e. the community of non-geographers who built tools and technologies without formal training in geography). A few years later, in 2008, the scientific community witnessed another major turning point through open access to the Landsat satellite archive, which had been collecting earth observation data since 1972. These moments were critical starting points of an explosion in geographic tools and data that today remains on a rapid upward trajectory. In more recent years, new additions in data and tools have come from the Free and Open Source Software (FOSS), open and volunteered data movements, new data collection methods (such as unmanned aerial vehicles, micro-satellites, real-time sensors), and advances in computational technologies such as cloud and high performance computing (HPC). However, within the broader Data Science community, specific attention was often not given to the unique characteristics (e.g. spatial dependence) and evolutions in geospatial data (e.g. increasing temporal/spatial resolutions and extents). Beginning in 2015, researchers such as Luc Anselin as well as others who had been developing geospatial cyber-infrastructure (CyberGIS) since 2008 began to call for a Spatial Data Science, a field that could leverage the advances from Data Science, such as data mining, machine

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learning, and other statistical and visualization 'big' data techniques, for geospatial data. New challenges have emerged from this rapid expansion in data and tool options: how to scale analyses for 'big' data; deal with uncertainty and quality for data synthesis; evaluate options and choose the right data or tool; integrate options when only one will not suffice; and use emerging tools to effectively collaborate on increasingly more multi-disciplinary and multi-dimensional research that aims to address our current societal and environmental challenges, such as climate change, loss of biodiversity and natural areas, and wildfire management. This dissertation addresses in part these challenges by applying emerging methods and tools in Spatial Data Science (such as cloud-computing, cluster analysis and machine learning) to develop new frameworks for evaluating geospatial tools based on collaborative potential and for evaluating and integrating competing remotely-sensed map products of vegetation change and disturbance. In Chapter One, I discuss in further detail the historical trajectory toward a Spatial Data Science and provide a new working definition of the field that recognizes its interdisciplinary and collaborative potential and that serves as the guiding conceptual foundation of this dissertation. In Chapter Two, I identify the key components of a collaborative Spatial Data Science workflow to develop a framework for evaluating the various functional aspects of multi-user geospatial tools. Using this framework, I then score thirty-one existing tools and apply a cluster analysis to create a typology of these tools. I present this typology as the first

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map of the emergent ecosystem and functional niches of collaborative geospatial tools. I identify three primary clusters of tools composed of eight secondary clusters across which divergence is driven by required infrastructure and user involvement. I use my results to highlight how environmental collaborations have benefited from these tools and propose key areas of future tool development for continued support of collaborative geospatial efforts. In Chapters Three and Four, I apply Spatial Data Science within a case study of California fire to compare the differences as well as explore the synergies between the three remotely-sensed map products of vegetation disturbance for 2001-2010: Hansen Global Forest Change (GFC); North American Forest Dynamics (NAFD); and Landscape Fire and Resource Management Planning Tools (LANDFIRE). Specifically, Chapter Three identifies the implications of the differing creation methods of these products on their representations of disturbance and fire. I identify that LANDFIRE (the traditional created product that integrates field data and public data on disturbance events with remote sensing) reported the highest amount of vegetation disturbance across all years and habitat types, as compared to GFC and NAFD, which are both produced from automated remote sensing analyses. I also find that these differences in reported disturbance are driven by differential inclusion of reference data on fire (rather than differences in environmental conditions) and identify the widest range in reported disturbance (i.e. more uncertainty) in years with more fire incidence and in scrub/shrub habitat. In Chapter Four, I use spatial agreement among the

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competing products as a measure of uncertainty. I identify low uncertainty in disturbance (i.e. where all products agree) across only 15% of the total area of California that was reported as disturbed by at least one product between 2001 and 2010. Specifically, I find that scrub/shrub habitat had a lower uncertainty of disturbance than forest, particularly for fire, and that uncertainty was universally high across all bioregions. I also identify that LANDFIRE was solely responsible for approximately 50% of the total area reported as disturbed and find large differences between the burned areas reported by the reference data and the areas with low uncertainty of disturbance, indicating potential overestimation of disturbance by both LANDFIRE and the reference data on fire. Last, in Chapter Five, I conclude by highlighting how unresolved key challenges for Spatial Data Science can serve as new opportunities to guide the scaling of methods for “big” data, increased spatial-temporal integration, as well as promote new curriculum to better prepare future Spatial Data Scientists. In all, this dissertation explores the opportunities and challenges posed by Spatial Data Science and serves as a guiding reference for professionals and practitioners to successfully navigate the changing world of geospatial data and tools.

From the Foreword: "While large-scale machine learning and data mining have greatly impacted a range of commercial applications, their use in the field of Earth sciences is still in the early stages. This book, edited by Ashok Srivastava, Ramakrishna Nemani, and Karsten Steinhaeuser, serves as an outstanding resource for anyone interested in

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the opportunities and challenges for the machine learning community in analyzing these data sets to answer questions of urgent societal interest...I hope that this book will inspire more computer scientists to focus on environmental applications, and Earth scientists to seek collaborations with researchers in machine learning and data mining to advance the frontiers in Earth sciences." --Vipin Kumar, University of Minnesota

Large-Scale Machine Learning in the Earth Sciences provides researchers and practitioners with a broad overview of some of the key challenges in the intersection of Earth science, computer science, statistics, and related fields. It explores a wide range of topics and provides a compilation of recent research in the application of machine learning in the field of Earth Science. Making predictions based on observational data is a theme of the book, and the book includes chapters on the use of network science to understand and discover teleconnections in extreme climate and weather events, as well as using structured estimation in high dimensions. The use of ensemble machine learning models to combine predictions of global climate models using information from spatial and temporal patterns is also explored. The second part of the book features a discussion on statistical downscaling in climate with state-of-the-art scalable machine learning, as well as an overview of methods to understand and predict the proliferation of biological species due to changes in environmental conditions. The problem of using large-scale machine learning to study the formation of tornadoes is also explored in depth. The last part of the book covers the use of deep learning algorithms to classify

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Images that have very high resolution, as well as the unmixing of spectral signals in remote sensing images of land cover. The authors also apply long-tail distributions to geoscience resources, in the final chapter of the book.

A graduate textbook that provides a unified treatment of machine learning methods and their applications in the environmental sciences.

This book presents the basic concepts of quantitative soil science and, within this framework, it seeks to construct a new body of knowledge. There is a growing need for quantitative approach in soil science, which arises from a general demand for improved economic production and environmental management. Pedometrics can be defined as the development and application of statistical and mathematical methods applicable to data analysis problems in soil science. This book shows how pedometrics can address key soil-related questions from a quantitative point of view. It addresses four main areas which are akin to the problems of conventional pedology: (i) Understanding the pattern of soil distribution in character space – soil classification, (ii) Understanding soil spatial and temporal variation, (iii) Evaluating the utility and quality of soil and ultimately, (iv) Understanding the genesis of soil. This is the first book that address these problems in a coherent quantitative approach.

As computer and space technologies have been developed, geoscience information systems (GIS) and remote sensing (RS) technologies, which deal with the geospatial information, have been rapidly maturing. Moreover, over the last few decades, machine

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learning techniques including artificial neural network (ANN), deep learning, decision tree, and support vector machine (SVM) have been successfully applied to geospatial science and engineering research fields. The machine learning techniques have been widely applied to GIS and RS research fields and have recently produced valuable results in the areas of geoscience, environment, natural hazards, and natural resources. This book is a collection representing novel contributions detailing machine learning techniques as applied to geoscience information systems and remote sensing. The experience developed by Ian McHarg represents the first attempt to base environmental planning on more objective methods. In particular, he supposed that the real world can be considered as a layer cake and each layer represents a sectoral analysis. This metaphor represents the fundamental of overlay mapping. At the beginning, these principles have been applied only by hand, just considering the degree of darkness, produced by layer transparency, as a negative impact. In the following years, this craftmade approach, has been adopted for data organization in Geographical Information Systems producing analyses with a high level of quality and rigour. Nowadays, great part of studies in environmental planning field have been developed using GIS. The next step relative to the simple use of geographic information in supporting environmental planning is the adoption of spatial simulation models, which can predict the evolution of phenomena. As the use of spatial information has definitely improved the quality of data sets on which basing decision-making process, the use of

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Geostatistics, spatial simulation and, more generally, geocomputation methods allows the possibility of basing the decision-making process on predicted future scenarios. It is very strange that a discipline such as planning which programs the territory for the future years in great part of cases is not based on simulation models. Sectoral analyses, often based on surveys, are not enough to highlight dynamics of an area. Better knowing urban and environmental changes occurred in the past, it is possible to provide better simulations to predict possible tendencies. The aim of this book is to provide an overview of the main methods and techniques adopted in the field of environmental geocomputation in order to produce a more sustainable development. This book discusses machine learning algorithms, such as artificial neural networks of different architectures, statistical learning theory, and Support Vector Machines used for the classification and mapping of spatially distributed data. It presents basic geostatistical algorithms as well. The authors describe new trends in machine learning and their application to spatial data. The text also includes real case studies based on environmental and pollution data. It includes a CD-ROM with software that will allow both students and researchers to put the concepts to practice.

Data Science Applied to Sustainability Analysis focuses on the methodological considerations associated with applying this tool in analysis techniques such as

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lifecycle assessment and materials flow analysis. As sustainability analysts need examples of applications of big data techniques that are defensible and practical in sustainability analyses and that yield actionable results that can inform policy development, corporate supply chain management strategy, or non-governmental organization positions, this book helps answer underlying questions. In addition, it addresses the need of data science experts looking for routes to apply their skills and knowledge to domain areas. Presents data sources that are available for application in sustainability analyses, such as market information, environmental monitoring data, social media data and satellite imagery Includes considerations sustainability analysts must evaluate when applying big data Features case studies illustrating the application of data science in sustainability analyses

Ecologists and natural resource managers are charged with making complex management decisions in the face of a rapidly changing environment resulting from climate change, energy development, urban sprawl, invasive species and globalization. Advances in Geographic Information System (GIS) technology, digitization, online data availability, historic legacy datasets, remote sensors and the ability to collect data on animal movements via satellite and GPS have given rise to large, highly complex datasets. These datasets could be utilized for

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making critical management decisions, but are often “messy” and difficult to interpret. Basic artificial intelligence algorithms (i.e., machine learning) are powerful tools that are shaping the world and must be taken advantage of in the life sciences. In ecology, machine learning algorithms are critical to helping resource managers synthesize information to better understand complex ecological systems. Machine Learning has a wide variety of powerful applications, with three general uses that are of particular interest to ecologists: (1) data exploration to gain system knowledge and generate new hypotheses, (2) predicting ecological patterns in space and time, and (3) pattern recognition for ecological sampling. Machine learning can be used to make predictive assessments even when relationships between variables are poorly understood. When traditional techniques fail to capture the relationship between variables, effective use of machine learning can unearth and capture previously unattainable insights into an ecosystem's complexity. Currently, many ecologists do not utilize machine learning as a part of the scientific process. This volume highlights how machine learning techniques can complement the traditional methodologies currently applied in this field.

The two volume set LNCS 10424 and 10425 constitutes the refereed proceedings of the 17th International Conference on Computer Analysis of

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Images and Patterns, CAIP 2017, held in Ystad, Sweden, in August 2017. The 72 papers presented were carefully reviewed and selected from 144 submissions. The papers are organized in the following topical sections: Vision for Robotics; Motion and Tracking; Segmentation; Image/Video Indexing and Retrieval; Shape Representation and Analysis; Biomedical Image Analysis; Biometrics; Machine Learning; Image Restoration; and Poster Sessions.

Advances in Geo-Spatial Information Science presents recent advances regarding fundamental issues of geo-spatial information science (space and time, spatial analysis, uncertainty modeling and geo-visualization), and new scientific and technological research initiatives for geo-spatial information science (such as spatial data mining, mobile data modeling, and location-based services). The book contains selected and revised papers presented at the joint International Conference on Theory, Data Handling and Modelling in GeoSpatial Information Science (Hong Kong, 26–28 May 2010), and brings together three related international academic communities: spatial information science, spatial data handling, and modeling geographic systems. Advances in Geo-Spatial Information Science will be of interest for academics and professionals interested in spatial information science, spatial data handling, and modeling of geographic systems.

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Combining versatile data sets from multiple satellite sensors with advanced thematic information retrieval is a powerful way for studying complex earth systems. The book *Multisensor Data Fusion and Machine Learning for Environmental Remote Sensing* offers complete understanding of the basic scientific principles needed to perform image processing, gap filling, data merging, data fusion, machine learning, and feature extraction. Written by two experts in remote sensing, the book presents the required basic concepts, tools, algorithms, platforms, and technology hubs toward advanced integration. By merging and fusing data sets collected from different satellite sensors with common features, we are enabled to utilize the strength of each satellite sensor to the maximum extent. The inclusion of machine learning or data mining techniques to aid in feature extraction after gap filling, data merging and/or data fusion further empowers earth observation, leading to confirm the whole is greater than the sum of its parts. Contemporary applications discussed in this book make all essential knowledge seamlessly integrated by an interdisciplinary manner. These case-based engineering practices uniquely illustrate how to improve such an emerging field of importance to cope with the most challenging real-world environmental monitoring issues.

This book is intended for researchers, practitioners and students who are

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Interested in the current trends and want to make their GI applications and research dynamic. Time is the key element of contemporary GIS: mobile and wearable electronics, sensor networks, UAVs and other mobile snoopers, the IoT and many other resources produce a massive amount of data every minute, which is naturally located in space as well as in time. Time series data is transformed into almost (from the human perspective) continuous data streams, which require changes to the concept of spatial data recording, storage and manipulation. This book collects the latest innovative research presented at the GIS Ostrava 2017 conference held in 2017 in Ostrava, Czech Republic, under the auspices of EuroSDR and EuroGEO. The accepted papers cover various aspects of dynamics in GIScience, including spatiotemporal data analysis and modelling; spatial mobility data and trajectories; real-time geodata and real-time applications; dynamics in land use, land cover and urban development; visualisation of dynamics; open spatiotemporal data; crowdsourcing for spatiotemporal data and big spatiotemporal data.

Spatial Modeling in GIS and R for Earth and Environmental Sciences offers an integrated approach to spatial modelling using both GIS and R. Given the importance of Geographical Information Systems and geostatistics across a variety of applications in Earth and Environmental Science, a clear link between

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GIS and open source software is essential for the study of spatial objects or phenomena that occur in the real world and facilitate problem-solving. Organized into clear sections on applications and using case studies, the book helps researchers to more quickly understand GIS data and formulate more complex conclusions. The book is the first reference to provide methods and applications for combining the use of R and GIS in modeling spatial processes. It is an essential tool for students and researchers in earth and environmental science, especially those looking to better utilize GIS and spatial modeling. Offers a clear, interdisciplinary guide to serve researchers in a variety of fields, including hazards, land surveying, remote sensing, cartography, geophysics, geology, natural resources, environment and geography Provides an overview, methods and case studies for each application Expresses concepts and methods at an appropriate level for both students and new users to learn by example This book constitutes the proceedings of the 12th International Conference on Spatial Information Theory, COSIT 2015, held in Santa Fee, NM, USA, in October 2015. The 22 papers presented in this book were carefully reviewed and selected from 52 full paper submissions. The following topics are addressed: formalizing and modeling space-time, qualitative spatio-temporal reasoning and representation, language and space, signs, images, maps, and other

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representations of space, navigations by humans and machines.

The ability to create automated algorithms to process gridded spatial data is increasingly important as remotely sensed datasets increase in volume and frequency. Whether in business, social science, ecology, meteorology or urban planning, the ability to create automated applications to analyze and detect patterns in geospatial data is increasingly important. This book provides students with a foundation in topics of digital image processing and data mining as applied to geospatial datasets. The aim is for readers to be able to devise and implement automated techniques to extract information from spatial grids such as radar, satellite or high-resolution survey imagery.

This book will help decision makers model nature-based solutions to the complex problem of sustainable development, locally and globally.

Accompanying CD-RM contains Machine learning office software, MLO guide (pdf) and examples of data.

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