

# MODELINGUNCERTAINTY Earth Sciences

JEF CAERS

# **Modeling Uncertainty In The Earth Sciences**

**B.S. Daya Sagar, Qiuming Cheng, Frits Agterberg** 

#### **Modeling Uncertainty In The Earth Sciences:**

Modeling Uncertainty in the Earth Sciences Jef Caers, 2011-05-25 Modeling Uncertainty in the Earth Sciences highlights the various issues techniques and practical modeling tools available for modeling the uncertainty of complex Earth systems and the impact that it has on practical situations The aim of the book is to provide an introductory overview which covers a broad range of tried and tested tools Descriptions of concepts philosophies challenges methodologies and workflows give the reader an understanding of the best way to make decisions under uncertainty for Earth Science problems The book covers key issues such as Spatial and time aspect large complexity and dimensionality computation power costs of engineering the Earth uncertainty in the modeling and decision process Focusing on reliable and practical methods this book provides an invaluable primer for the complex area of decision making with uncertainty in the Earth Sciences Seismic Reservoir Modeling Dario Grana, Tapan Mukerji, Philippe Doyen, 2021-05-04 Seismic reservoir characterization aims to build 3 dimensional models of rock and fluid properties including elastic and petrophysical variables to describe and monitor the state of the subsurface for hydrocarbon exploration and production and for CO2 sequestration Rock physics modeling and seismic wave propagation theory provide a set of physical equations to predict the seismic response of subsurface rocks based on their elastic and petrophysical properties However the rock and fluid properties are generally unknown and surface geophysical measurements are often the only available data to constrain reservoir models far away from well control Therefore reservoir properties are generally estimated from geophysical data as a solution of an inverse problem by combining rock physics and seismic models with inverse theory and geostatistical methods in the context of the geological modeling of the subsurface A probabilistic approach to the inverse problem provides the probability distribution of rock and fluid properties given the measured geophysical data and allows quantifying the uncertainty of the predicted results The reservoir characterization problem includes both discrete properties such as facies or rock types and continuous properties such as porosity mineral volumes fluid saturations seismic velocities and density Seismic Reservoir Modeling Theory Examples and Algorithms presents the main concepts and methods of seismic reservoir characterization The book presents an overview of rock physics models that link the petrophysical properties to the elastic properties in porous rocks and a review of the most common geostatistical methods to interpolate and simulate multiple realizations of subsurface properties conditioned on a limited number of direct and indirect measurements based on spatial correlation models The core of the book focuses on Bayesian inverse methods for the prediction of elastic petrophysical properties from seismic data using analytical and numerical statistical methods The authors present basic and advanced methodologies of the current state of the art in seismic reservoir characterization and illustrate them through expository examples as well as real data applications to hydrocarbon reservoirs and CO2 sequestration studies **Computational Challenges in the Geosciences Clint** Dawson, Margot Gerritsen, 2013-09-17 Computational Challenges in the Geosciences addresses a cross section of grand

challenge problems arising in geoscience applications including groundwater and petroleum reservoir simulation hurricane storm surge oceanography volcanic eruptions and landslides and tsunamis Each of these applications gives rise to complex physical and mathematical models spanning multiple space time scales which can only be studied through computer simulation The data required by the models is often highly uncertain and the numerical solution of the models requires sophisticated algorithms which are mathematically accurate computationally efficient and yet must preserve basic physical properties of the models This volume summarizes current methodologies and future research challenges in this broad and Advances in Geophysics Cedric Schmelzbach, 2018-11-13 Advances in Geophysics is a highly respected publication in the field of geophysics Since 1952 each volume has been eagerly awaited frequently consulted and praised by researchers and reviewers alike Now with over 50 volumes the series contains much material still relevant today truly an essential publication for researchers in all fields of geophysics Provides high level reviews of the latest innovations in geophysics Written by recognized experts in the field Presents an essential publication for researchers in all fields of <u>Issues in Earth Sciences</u>, <u>Geology</u>, and <u>Geophysics</u>: <u>2013 Edition</u>, 2013-05-01 Issues in Earth Sciences geophysics Geology and Geophysics 2013 Edition is a Scholarly Editions book that delivers timely authoritative and comprehensive information about Geomagnetism and Aeronomy The editors have built Issues in Earth Sciences Geology and Geophysics 2013 Edition on the vast information databases of ScholarlyNews You can expect the information about Geomagnetism and Aeronomy in this book to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Issues in Earth Sciences Geology and Geophysics 2013 Edition has been produced by the world's leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at http www Handbook of Mathematical Geosciences B.S. Dava Sagar, Qiuming Cheng, Frits ScholarlyEditions com Agterberg, 2018-06-25 This Open Access handbook published at the IAMG s 50th anniversary presents a compilation of invited path breaking research contributions by award winning geoscientists who have been instrumental in shaping the IAMG It contains 45 chapters that are categorized broadly into five parts i theory ii general applications iii exploration and resource estimation iv reviews and v reminiscences covering related topics like mathematical geosciences mathematical morphology geostatistics fractals and multifractals spatial statistics multipoint geostatistics compositional data analysis informatics geocomputation numerical methods and chaos theory in the geosciences **Characterization of Ore-Forming** Systems from Geological, Geochemical and Geophysical Studies K. Gessner, T.G. Blenkinsop, P. Sorjonen-Ward, 2018-08-07 Economically viable concentrations of mineral resources are uncommon in Earth's crust Most ore deposits that were mined in the past or are currently being extracted were found at or near Earth's surface often

serendipitously To meet the future demand for mineral resources exploration success hinges on identifying targets at depth Achieving this requires accurate and informed models of the Earth's crust that are consistent with all available geological geochemical and geophysical information paired with an understanding of how ore forming systems relate to Earth's evolving structure Contributions to this volume address the future resources challenge by i applying advanced microscale geochemical detection and characterization methods ii introducing more rigorous 3D Earth models iii exploring critical behaviour and coupled processes iv evaluating the role of geodynamic and tectonic setting and v applying 3D structural models to characterize specific ore forming systems Statistics for Data Science and Policy Analysis Azizur Rahman, 2020-03-31 This book brings together the best contributions of the Applied Statistics and Policy Analysis Conference 2019 Written by leading international experts in the field of statistics data science and policy evaluation This book explores the theme of effective policy methods through the use of big data accurate estimates and modern computing tools and statistical modelling Applied Statistical Modeling and Data Analytics Srikanta Mishra, Akhil Datta-Gupta, 2017-10-27 Applied Statistical Modeling and Data Analytics A Practical Guide for the Petroleum Geosciences provides a practical guide to many of the classical and modern statistical techniques that have become established for oil and gas professionals in recent years It serves as a how to reference volume for the practicing petroleum engineer or geoscientist interested in applying statistical methods in formation evaluation reservoir characterization reservoir modeling and management and uncertainty quantification Beginning with a foundational discussion of exploratory data analysis probability distributions and linear regression modeling the book focuses on fundamentals and practical examples of such key topics as multivariate analysis uncertainty quantification data driven modeling and experimental design and response surface analysis Data sets from the petroleum geosciences are extensively used to demonstrate the applicability of these techniques The book will also be useful for professionals dealing with subsurface flow problems in hydrogeology geologic carbon sequestration and nuclear waste disposal Authored by internationally renowned experts in developing and applying statistical methods for oil gas and other subsurface problem domains Written by practitioners for practitioners Presents an easy to follow narrative which progresses from simple concepts to more challenging ones Includes online resources with software applications and practical examples for the most relevant and popular statistical methods using data sets from the petroleum geosciences Addresses the theory and practice of statistical modeling and data analytics from the perspective of petroleum geoscience applications

Risk and Uncertainty Assessment for Natural Hazards Jonathan Rougier, Lisa J. Hill, Robert Stephen John
Sparks, 2013-02-21 A state of the art overview of natural hazard risk assessment for researchers and professionals in natural hazard science risk management and environmental science Geostatistical Reservoir Modeling Michael J. Pyrcz, Clayton V. Deutsch, 2014-04-16 Published in 2002 the first edition of Geostatistical Reservoir Modeling brought the practice of petroleum geostatistics into a coherent framework focusing on tools techniques examples and guidance It emphasized the

interaction between geophysicists geologists and engineers and was received well by professionals academics and both graduate and undergraduate students In this revised second edition Deutsch collaborates with co author Michael Pyrcz to provide an expanded in coverage and format full color illustrated more comprehensive treatment of the subject with a full update on the latest tools methods practice and research in the field of petroleum Geostatistics Key geostatistical concepts such as integration of geologic data and concepts scale considerations and uncertainty models receive greater attention and new comprehensive sections are provided on preliminary geological modeling concepts data inventory conceptual model problem formulation large scale modeling multiple point based simulation and event based modeling Geostatistical methods are extensively illustrated through enhanced schematics work flows and examples with discussion on method capabilities and selection For example this expanded second edition includes extensive discussion on the process of moving from an inventory of data and concepts through conceptual model to problem formulation to solve practical reservoir problems A greater number of examples are included with a set of practical geostatistical studies developed to illustrate the steps from data analysis and cleaning to post processing and ranking New methods which have developed in the field since the publication of the first edition are discussed such as models for integration of diverse data sources multiple point based simulation event Geostatistics Unraveled: A based simulation spatial bootstrap and methods to summarize geostatistical realizations Comprehensive Guide to Making Sense of Earth Science Data Pasquale De Marco, 2025-08-11 Embark on a journey into the captivating realm of geostatistics where data unveils the secrets of Earth's intricate systems Discover how geostatistical techniques transform raw data into actionable insights empowering earth scientists to make informed decisions and address complex challenges Within these pages you ll find a comprehensive guide to geostatistics encompassing its fundamental principles methodologies and applications Delve into the art of exploratory data analysis unraveling patterns and trends hidden within geological information Master the techniques of geostatistical estimation kriging and simulation unlocking the secrets of spatial variability and uncertainty Geostatistics finds its home in a diverse array of disciplines from mining and exploration to hydrogeology environmental science and agriculture In each of these domains geostatistics serves as an indispensable tool aiding in resource assessment risk evaluation and decision making Witness how geostatistical models optimize mining operations guide groundwater management strategies and inform environmental remediation efforts through real world case studies Written in an engaging and accessible style this book invites readers to grasp the essence of geostatistical concepts and their practical applications With a focus on contextually relevant examples the authors demonstrate how geostatistics empowers earth scientists to solve complex problems and make a positive impact on the world Whether you re a student seeking a deeper understanding of geostatistics a professional seeking to enhance your skills or simply someone fascinated by the interplay of statistics and geology this book is your gateway to unlocking the power of geostatistics Join the journey and discover the transformative power of data in shaping our understanding of Earth's systems

If you like this book write a review Hydrogeology Alain Dassargues, 2018-09-03 This text combines the science and engineering of hydrogeology in an accessible innovative style As well as providing physical descriptions and characterisations of hydrogeological processes it also sets out the corresponding mathematical equations for groundwater flow and solute heat transport calculations And within this the methodological and conceptual aspects for flow and contaminant transport modelling are discussed in detail This comprehensive analysis forms the ideal textbook for graduate and undergraduate students interested in groundwater resources and engineering and indeed its analyses can apply to researchers and professionals involved in the area Rapid, Reproducible, and Robust Environmental Modeling for Decision Support: Worked Examples and Open-Source Software Tools Jeremy White, Michael Fienen, Catherine Moore, Anneli The Future of Geological Modelling in Hydrocarbon Development Adam Robinson, 2008 The 3D Guthke, 2023-10-11 geological model is still regarded as one of the newest and most innovative tools for reservoir management purposes The computer modelling of structures rock properties and fluid flow in hydrocarbon reservoirs has evolved from a specialist activity to part of the standard desktop toolkit The application of these techniques has allowed all disciplines of the subsurface team to collaborate in a common workspace In today s asset teams the role of the geological model in hydrocarbon development planning is key and will be for some time ahead The challenges that face the geologists and engineers will be to provide more seamless interaction between static and dynamic models. This interaction requires the development of conventional and unconventional modelling algorithms and methodologies in order to provide more risk assessed scenarios thus enabling geologists and engineers to better understand and capture inherent uncertainties at each aspect of the geological model s life Carbon Fluxes and Biophysical Variables from Earth Observation Manuel Campos-Taberner, Beatriz Martínez, Sergio Sánchez-Ruiz, 2025-06-27 Carbon Fluxes and Biophysical Variables from Earth Observation Methods for Ecosystem Assessment transforms the way remote sensing data can be used to approach monitoring of carbon fluxes CF and biophysical variables BV in ecosystem and global vegetation monitoring In a field where these two subjects have traditionally been treated as distinct entities this book offers an integrated exploration of CF and BV retrieval through remote sensing It not only delves into a wide array of approaches and methodologies but also assists readers in selecting the most suitable models based on available inputs and spatiotemporal scales Carbon Fluxes and Biophysical Variables from Earth Observation is a useful resource for Earth Observation specialists particularly in Remote Sensing machine learning ecology and plant physiology to enhance and adapt their approaches and methodologies Provides multidisciplinary approaches to the use of remote sensing for monitoring carbon fluxes and biophysical variables Enables deeper understanding and monitoring of ecosystems and dynamics from Earth observation technologies Includes in situ local scale and global methods to provide readers with techniques and applications for a wide spectrum of needs **Advances in** Geophysics, Tectonics and Petroleum Geosciences Mustapha Meghraoui, Narasimman Sundararajan, Santanu

Banerjee, Klaus-G. Hinzen, Mehdi Eshagh, François Roure, Helder I. Chaminé, Said Maouche, André Michard, 2022-04-21 This edited book is based on the best papers accepted for presentation during the 2nd Springer Conference of the Arabian Journal of Geosciences CAJG 2 Tunisia in 2019 It is of interest to all researchers practicing geophysics seismology structural and petroleum geology With four sections spanning a large spectrum of geological and geophysical topics with particular reference to Middle East Mediterranean region and Africa this book presents a series of research methods that are nowadays in use for measuring quantifying and analyzing several geological domains It starts with a subsection dedicated to the latest research studies on seismic hazard and risk assessment in Africa presented during the 2019 IGCP 659 meeting organized alongside the CAJG 2 And it includes new research studies on earthquake geodesy seismotectonics archeoseismology and active faulting well logging methods geodesy and exploration theoretical geophysics petroleum geochemistry petroleum engineering structural geology basement architecture and potential data tectonics and geodynamics and thermicity petroleum and other georesources The edited book gives insights into the fundamental questions that address the genesis and evolution of our planet and this is based on data collection and experimental investigations under physical constitutive laws These multidisciplinary approaches combined with the geodynamics of tectonic provinces and investigations of potential zones of natural resources petroleum reservoirs provide the basis for a more sustainability in the economic development

Encyclopedia of Mathematical Geosciences B. S. Daya Sagar, Qiuming Cheng, Jennifer McKinley, Frits Agterberg, 2023-07-13 The Encyclopedia of Mathematical Geosciences is a complete and authoritative reference work It provides concise explanation on each term that is related to Mathematical Geosciences Over 300 international scientists each expert in their specialties have written around 350 separate articles on different topics of mathematical geosciences including contributions on Artificial Intelligence Big Data Compositional Data Analysis Geomathematics Geostatistics Geographical Information Science Mathematical Morphology Mathematical Petrology Multifractals Multiple Point Statistics Spatial Data Science Spatial Statistics and Stochastic Process Modeling Each topic incorporates cross referencing to related articles and also has its own reference list to lead the reader to essential articles within the published literature The entries are arranged alphabetically for easy access and the subject and author indices are comprehensive and extensive

Measuring and modeling the ground deformation of geological disasters using modern geodesy Xinjian Shan, Jeffrey Todd Freymueller, Caijun Xu, Zhenjie Wang, 2023-07-19 Closed Loop Management in Mineral Resource Extraction Jörg Benndorf, 2020-02-13 This book describes an innovative closed loop concept that allows the feedback of online data from operational monitoring to create mining intelligence The application of this concept promises significant improvements in economic and environmental key performance indicators for any mining operation Combining theory with industrial case studies the book guides readers through this process by providing theoretical background addressing practical issues related to operational implementation and illustrating the impact on selected examples This new concept is

presented using the example of a bulk and gold mining application but is applicable at any mine where grade control is important The book is of interest to industrial professionals involved in operational monitoring mining intelligence and mine planning optimization as well as to researchers and academics in the field of applied geostatistics

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