

*Advances in*  
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*VOLUME 40*

**Long-Range Persistence  
in Geophysical Time Series**



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# Long Range Persistence In Geophysical Time Series

**Harsh Gupta**



## **Long Range Persistence In Geophysical Time Series:**

*Advances in Geophysics*, 1999-06-18 *Advances in Geophysics* Vol 40 systematically compares many of the currently used statistical approaches to time series analysis and modeling to evaluate each method's robustness and application to geophysical datasets. This volume tackles the age-old problem of how to evaluate the relative roles of deterministic versus stochastic processes: signal vs noise in their observations. The book introduces the fundamentals in sections titled 1.2 What is a Time Series and 1.3 How is a Time Series Quantified, before diving into Spectral Analysis, Semivariograms, Rescaled Range Analysis, and Wavelet Analysis. The second half of the book applies their self-affine analysis to a number of geophysical time series: historical temperature records, drought hazard assessment, sedimentation in the context of hydrocarbon-bearing strata, variability of the Earth's magnetic field. This volume explores in detail one of the main components of noise: that of long range persistence or memory. The first chapter is a broad summary of theory and techniques of long range persistence in time series; the second chapter is the application of long range persistence to a variety of geophysical time series.

**Long-Range Dependence and Self-Similarity** Vlasos Pipiras, Murad S. Taqqu, 2017-04-18 This modern and comprehensive guide to long range dependence and self-similarity starts with rigorous coverage of the basics, then moves on to cover more specialized up-to-date topics central to current research. These topics concern but are not limited to physical models that give rise to long range dependence and self-similarity, central and non-central limit theorems for long range dependent series, and the limiting Hermite processes, fractional Brownian motion, and its stochastic calculus, several celebrated decompositions of fractional Brownian motion, multidimensional models for long range dependence and self-similarity, and maximum likelihood estimation methods for long range dependent time series. Designed for graduate students and researchers, each chapter of the book is supplemented by numerous exercises, some designed to test the reader's understanding while others invite the reader to consider some of the open research problems in the field today. *Advances in Geophysics* Renata Dmowska, Barry Saltzman, 1999-06-14

This series provides a venue for longer reviews of current advances in geophysics. Written at a level accessible to graduate students, the articles serve to broaden knowledge of various fields and may be useful in courses and seminars. Recent Advances in Time Series Forecasting Dinesh C.S. Bisht, Mangey Ram, 2021-09-07 Future predictions are always a topic of interest. Precise estimates are crucial in many activities as forecasting errors can lead to big financial loss. The sequential analysis of data and information gathered from past to present is called time series analysis. This book covers the recent advancements in time series forecasting. The book includes theoretical as well as recent applications of time series analysis. It focuses on the recent techniques used, discusses a combination of methodology and applications, presents traditional and advanced tools, new applications, and identifies the gaps in knowledge in engineering applications. This book is aimed at scientists, researchers, postgraduate students, and engineers in the areas of supply chain management, production, inventory planning, and statistical quality control. *Time Series Analysis in Seismology* Alejandro Ramírez-Rojas, Leonardo

Di G. Sigalotti, Elsa Leticia Flores Márquez, Otto Rendón, 2019-08-02 Time Series Analysis in Seismology Practical Applications provides technical assistance and coverage of available methods to professionals working in the field of seismology Beginning with a thorough review of open problems in geophysics including tectonic plate dynamics localization of solitons and forecasting the book goes on to describe the various types of time series or punctual processes obtained from those systems Additionally the book describes a variety of methods and techniques relating to seismology and includes a discussion of future developments and improvements Time Series Analysis in Seismology offers a concise presentation of the most recent advances in the analysis of geophysical data particularly with regard to seismology making it a valuable tool for researchers and students working in seismology and geophysics Presents the necessary tools for time series analysis as it relates to seismology in a compact and consistent manner Includes a discussion of technical resources that can be applied to time series data analysis across multiple disciplines Describes the methods and techniques available for solving problems related to the analysis of complex data sets Provides exercises at the end of each chapter to enhance comprehension

**Nonlinear and Stochastic Climate Dynamics** Christian L. E. Franzke, Terence J. O'Kane, 2017-01-19 It is now widely recognized that the climate system is governed by nonlinear multi scale processes whereby memory effects and stochastic forcing by fast processes such as weather and convective systems can induce regime behavior Motivated by present difficulties in understanding the climate system and to aid the improvement of numerical weather and climate models this book gathers contributions from mathematics physics and climate science to highlight the latest developments and current research questions in nonlinear and stochastic climate dynamics Leading researchers discuss some of the most challenging and exciting areas of research in the mathematical geosciences such as the theory of tipping points and of extreme events including spatial extremes climate networks data assimilation and dynamical systems This book provides graduate students and researchers with a broad overview of the physical climate system and introduces powerful data analysis and modeling methods for climate scientists and applied mathematicians

Climate Time Series Analysis Manfred Mudelsee, 2014-06-27 Climate is a paradigm of a complex system Analysing climate data is an exciting challenge which is increased by non normal distributional shape serial dependence uneven spacing and timescale uncertainties This book presents bootstrap resampling as a computing intensive method able to meet the challenge It shows the bootstrap to perform reliably in the most important statistical estimation techniques regression spectral analysis extreme values and correlation This book is written for climatologists and applied statisticians It explains step by step the bootstrap algorithms including novel adaptations and methods for confidence interval construction It tests the accuracy of the algorithms by means of Monte Carlo experiments It analyses a large array of climate time series giving a detailed account on the data and the associated climatological questions comprehensive mathematical and statistical summary of time series analysis techniques geared towards climate applications accessible to readers with knowledge of college level calculus and statistics Computers and Geosciences A key part of the

book that separates it from other time series works is the explicit discussion of time uncertainty a very useful text for those wishing to understand how to analyse climate time series Journal of Time Series Analysis outstanding One of the best books on advanced practical time series analysis I have seen David J Hand Past President Royal Statistical Society **Persistence Time Series Analyses** Bruce D. Malamud,1998 **Fractals** Behzad Ghanbarian,Allen G. Hunt,2017-11-23 This book provides theoretical concepts and applications of fractals and multifractals to a broad range of audiences from various scientific communities such as petroleum chemical civil and environmental engineering atmospheric research and hydrology In the first chapter we introduce fractals and multifractals from physics and math viewpoints We then discuss theory and practical applications in detail In what follows in chapter 2 fragmentation process is modeled using fractals Fragmentation is the breaking of aggregates into smaller pieces or fragments a typical phenomenon in nature In chapter 3 the advantages and disadvantages of two and three phase fractal models are discussed in detail These two kinds of approach have been widely applied in the literature to model different characteristics of natural phenomena In chapter 4 two and three phase fractal techniques are used to develop capillary pressure curve models which characterize pore size distribution of porous media Percolation theory provides a theoretical framework to model flow and transport in disordered networks and systems Therefore following chapter 4 in chapter 5 the fractal basis of percolation theory and its applications in surface and subsurface hydrology are discussed In chapter 6 fracture networks are shown to be modeled using fractal approaches Chapter 7 provides different applications of fractals and multifractals to petrophysics and relevant area in petroleum engineering In chapter 8 we introduce the practical advantages of fractals and multifractals in geostatistics at large scales which have broad applications in stochastic hydrology and hydrogeology Multifractals have been also widely applied to model atmospheric characteristics such as precipitation temperature and cloud shape In chapter 9 these kinds of properties are addressed using multifractals At watershed scales river networks have been shown to follow fractal behavior Therefore the applications of fractals are addressed in chapter 10 Time series analysis has been under investigations for several decades in physics hydrology atmospheric research civil engineering and water resources In chapter 11 we therefore provide fractal multifractal multifractal detrended fluctuation analyses which can be used to study temporal characterization of a phenomenon such as flow discharge at a specific location of a river Chapter 12 addresses signals and again time series using a novel fractal Fourier analysis In chapter 13 we discuss constructal theory which has a perspective opposite to fractal theories and is based on optimization of diffusive exchange In the case of river drainages for example the constructal approach begins at the divide and generates headwater streams first rather than starting from the fundamental drainage pattern *Long-Range Dependent Processes: Theory and Applications* Ming Li,Carlo Cattani,2022-12-05 **Wavelets and Fractals in Earth System Sciences** E. Chandrasekhar,V. P. Dimri,V. M. Gadre,2013-11-20 The subject of wavelet analysis and fractal analysis is fast developing and has drawn a great deal of attention in varied disciplines of science and engineering

Over the past couple of decades wavelets multiresolution and multifractal analyses have been formalized into a thorough mathematical framework and have found a variety of applications with significant impact in several branches of earth system sciences Wavelets and Fractals in Earth System Sciences highlights the role of advanced data processing techniques in present day research in various fields of earth system sciences The book consists of ten chapters providing a well balanced blend of information about the role of wavelets fractals and multifractal analyses with the latest examples of their application in various research fields By combining basics with advanced material this book introduces concepts as needed and serves as an excellent introductory material and also as an advanced reference text for students and researchers **Fractal**

**Behaviour of the Earth System** V.P. Dimri, 2005-12-27 It is with pleasure that I write the foreword to this excellent book A wide range of observations in geology and solid earth geophysics can be explained in terms of fractal distributions In this volume a collection of papers considers the fractal behavior of the Earth's continental crust The book begins with an excellent introductory chapter by the editor Dr V P Dimri Surface gravity anomalies are known to exhibit power law spectral behavior under a wide range of conditions and scales This is self affine fractal behavior Explanations of this behavior remain controversial In chapter 2 V P Dimri and R P Srivastava model this behavior using Voronoi tessellations Another approach to understanding the structure of the continental crust is to use electromagnetic induction experiments Again the results often exhibit power law spectral behavior In chapter 3 K Bahr uses a fractal based random resistor network model to explain the observations Other examples of power law spectral observations come from a wide range of well logs using various logging tools In chapter 4 M Fedi D Fiore and M La Manna utilize multifractal models to explain the behavior of well logs from the main KTB borehole in Germany In chapter 5 V V Surkov and H Tanaka model the electrokinetic currents that may be associated with seismic electric signals using a fractal porous media In chapter 6 M Pervukhina Y Kuwahara and H Ito use fractal networks to correlate the elastic and electrical properties of porous media **Fractal Models in Exploration Geophysics**

V.P. Dimri, R.P. Srivastava, Nimisha Vedanti, 2012-07-17 Researchers in the field of exploration geophysics have developed new methods for the acquisition processing and interpretation of gravity and magnetic data based on detailed investigations of bore wells around the globe Fractal Models in Exploration Geophysics describes fractal based models for characterizing these complex subsurface geological structures The authors introduce the inverse problem using a fractal approach which they then develop with the implementation of a global optimization algorithm for seismic data very fast simulated annealing VFSA This approach provides high resolution inverse modeling results particularly useful for reservoir characterization Serves as a valuable resource for researchers studying the application of fractals in exploration and for practitioners directly applying field data for geo modeling Discusses the basic principles and practical applications of time lapse seismic reservoir monitoring technology application rapidly advancing topic Provides the fundamentals for those interested in reservoir geophysics and reservoir simulation study Demonstrates an example of reservoir simulation for enhanced oil recovery using

CO2 injection      **Theory and Applications of Long-Range Dependence** Paul Doukhan, George Oppenheim, Murad Taqqu, 2002-12-13 The area of data analysis has been greatly affected by our computer age For example the issue of collecting and storing huge data sets has become quite simplified and has greatly affected such areas as finance and telecommunications Even non specialists try to analyze data sets and ask basic questions about their structure One such question is whether one observes some type of invariance with respect to scale a question that is closely related to the existence of long range dependence in the data This important topic of long range dependence is the focus of this unique work written by a number of specialists on the subject The topics selected should give a good overview from the probabilistic and statistical perspective Included will be articles on fractional Brownian motion models inequalities and limit theorems periodic long range dependence parametric semiparametric and non parametric estimation long memory stochastic volatility models robust estimation and prediction for long range dependence sequences For those graduate students and researchers who want to use the methodology and need to know the tricks of the trade there will be a special section called Mathematical Techniques Topics in the first part of the book are covered from probabilistic and statistical perspectives and include fractional Brownian motion models inequalities and limit theorems periodic long range dependence parametric semiparametric and non parametric estimation long memory stochastic volatility models robust estimation prediction for long range dependence sequences The reader is referred to more detailed proofs if already found in the literature The last part of the book is devoted to applications in the areas of simulation estimation and wavelet techniques traffic in computer networks econometry and finance multifractal models and hydrology Diagrams and illustrations enhance the presentation Each article begins with introductory background material and is accessible to mathematicians a variety of practitioners and graduate students The work serves as a state of the art reference or graduate seminar text      **Index for Volumes 1-41** ,1999-06-18 This series provides a venue for longer reviews of current advances in geophysics Written at a level accessible to graduate students the articles serve to broaden knowledge of various fields and may be useful in courses and seminars      **Mobile Computing, Applications, and Services** Yuyu Yin, Ying Li, Honghao Gao, Jilin Zhang, 2019-09-24 This book constitutes the thoroughly refereed post conference proceedings of the 10th International Conference on Mobile Computing Applications and Services MobiCASE 2019 held in Hangzhou China in June 2019 The 17 full papers were carefully reviewed and selected from 48 submissions The papers are organized in topical sections on mobile application with data analysis mobile application with AI edge computing energy optimization and application      **Climate Change** Juan A. Blanco, Houshang Kheradmand, 2011-09-12 This book offers an interdisciplinary view of the biophysical issues related to climate change Climate change is a phenomenon by which the long term averages of weather events i e temperature precipitation wind speed etc that define the climate of a region are not constant but change over time There have been a series of past periods of climatic change registered in historical or paleoecological records In the first section of this book a series of state of the

art research projects explore the biophysical causes for climate change and the techniques currently being used and developed for its detection in several regions of the world The second section of the book explores the effects that have been reported already on the flora and fauna in different ecosystems around the globe Among them the ecosystems and landscapes in arctic and alpine regions are expected to be among the most affected by the change in climate as they will suffer the more intense changes The final section of this book explores in detail those issues

**Nonlinear Dynamics in Geosciences** Anastasios A. Tsonis, James B. Elsner, 2007-10-23 Nonlinear Dynamics in Geosciences is comprised of the proceedings of 20 Years of Nonlinear Dynamics in Geosciences held June 11-16 2006 in Rhodes Greece as part of the Aegean Conferences The volume brings together the most up to date research from the atmospheric sciences hydrology geology and other areas of geosciences and discusses the advances made and the future directions of nonlinear dynamics Topics covered include predictability ensemble prediction nonlinear prediction nonlinear time series analysis low dimensional chaos nonlinear modeling fractals and multifractals bifurcation and other aspects of nonlinear science

**Encyclopedia of Solid Earth Geophysics** Harsh Gupta, 2011-06-29 The past few decades have witnessed the growth of the Earth Sciences in the pursuit of knowledge and understanding of the planet that we live on This development addresses the challenging endeavor to enrich human lives with the bounties of Nature as well as to preserve the planet for the generations to come Solid Earth Geophysics aspires to define and quantify the internal structure and processes of the Earth in terms of the principles of physics and forms the intrinsic framework which other allied disciplines utilize for more specific investigations The first edition of the Encyclopedia of Solid Earth Geophysics was published in 1989 by Van Nostrand Reinhold publishing company More than two decades later this new volume edited by Prof Harsh K Gupta represents a thoroughly revised and expanded reference work It brings together more than 200 articles covering established and new concepts of Geophysics across the various sub disciplines such as Gravity Geodesy Geomagnetism Seismology Seismics Deep Earth Processes Plate Tectonics Thermal Domains Computational Methods etc in a systematic and consistent format and standard It is an authoritative and current reference source with extraordinary width of scope It draws its unique strength from the expert contributions of editors and authors across the globe It is designed to serve as a valuable and cherished source of information for current and future generations of professionals

**Complexity in Economic and Social Systems** Stanisław Drożdż, Jarosław Kwapien, Paweł Oświęcimka, 2021-05-11 There is no term that better describes the essential features of human society than complexity On various levels from the decision making processes of individuals through to the interactions between individuals leading to the spontaneous formation of groups and social hierarchies up to the collective herding processes that reshape whole societies all these features share the property of irreducibility i e they require a holistic multi level approach formed by researchers from different disciplines This Special Issue aims to collect research studies that by exploiting the latest advances in physics economics complex networks and data science make a step towards understanding these economic



and social systems The majority of submissions are devoted to financial market analysis and modeling including the stock and cryptocurrency markets in the COVID 19 pandemic systemic risk quantification and control wealth condensation the innovation related performance of companies and more Looking more at societies there are papers that deal with regional development land speculation and the fake news fighting strategies the issues which are of central interest in contemporary society On top of this one of the contributions proposes a new improved complexity measure

## **Long Range Persistence In Geophysical Time Series** Book Review: Unveiling the Power of Words

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