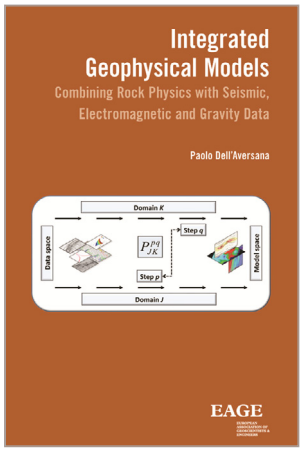
GEOQ BOOKS

Integrated Geophysical Models

Combining Rock Physics with Seismic, Electromagnetic and Gravity Data



By Paolo Dell'Aversana

EAGE PUBLICATIONS

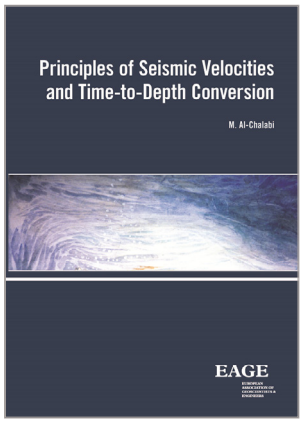
244 pages | Paperback
1st edition | 2014
ISBN 9789073834927

Price: €75 (€60 for EAGE members)

Publisher's summary (abridged)

The growing interest for electromagnetic and gravity methods, together with the availability of high quality seismic data, justifies the development of efficient methodologies for combining heterogeneous geophysical information into multi-parametric models. This book discusses different approaches for building integrated geophysical models using seismic, electromagnetic and gravity data. The book focuses mainly on land and offshore geophysical data acquired at the surface. However, also borehole data is considered as a fundamental support for geophysical integration. Integrated acquisition techniques will be included in the discussion, but the focus is mainly on integrated model building.

Principles of Seismic Velocities and Time-to-Depth Conversion



By M. Al-Chalabi

EAGE PUBLICATIONS

491 pages | Hardback
1st edition | 2014
ISBN 9789073834873

Price: €125 (€99 for EAGE members)

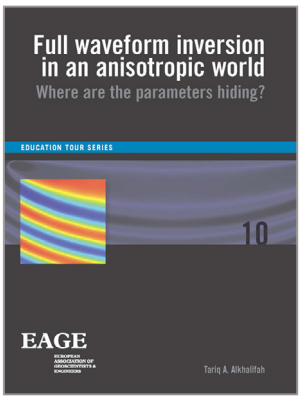
Publisher's summary (abridged)

Despite its fundamental importance for acquiring an accurate picture of the subsurface, the topic of time-to-depth conversion on the basis of true propagation velocities has never been addressed in the form of a comprehensive, dedicated book. The present book has long been overdue for bridging this obvious gap in geoscience. Geophysicists proficient in data processing fully appreciate that depth imaging, despite the excellence achieved in data quality and lateral positioning, does not amount to true or accurate depth conversion. This is because modelling 'velocities' in processing (described in the book as 'pro-velocities') can often be quite different from the actual propagation velocities. The book is written for the interpretation geophysicist working in exploration and development and for the seismic processor seeking a wider perspective on the quality of output and on the provision of the data to help the 'frontline' geoscientist. The geologist using geophysical methods as a tool at various levels of detail in the evaluation of the subsurface, and the geoscientist at large, may also find the manuscript useful.

BACK TO CONTENTS

Full waveform inversion in an anisotropic world

Where are the parameters hiding?



By T.A. Alkhalifah

EAGE PUBLICATIONS

204 pages | Paperback
1st edition | 2014
ISBN 9789073834835

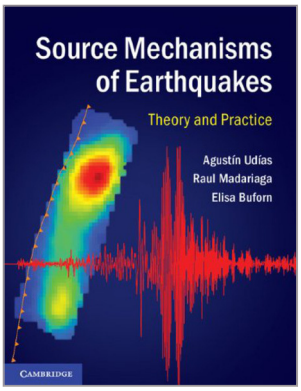
Price: €75 (€60 for EAGE members)

Publisher's summary (abridged)

This book offers a gentle yet scientific introduction to the hot topic of full waveform inversion (FWI) with a focus on its practical application to anisotropic media. It includes discussion of a mix of classical developments in FWI based on a simple framework, as well as critical new developments that address current challenges. Recent FWI case study results, as well as our experience with imaging seismic data, suggest the necessity of taking the anisotropic nature of the Earth into consideration. Unlike elasticity or attenuation, anisotropy actually affects the kinematics of the wavefield, in addition to the amplitudes. Many practical implementations of FWI ignore the elastic nature of the Earth and use the S-wave free acoustic assumption by reducing the impact of amplitudes. The importance of including at least acoustic amplitudes is, however, becoming more and more apparent. The goal of this book is to provide a recipe for practical anisotropic FWI, with proper FWI setups and anisotropy parameter representations.

Source Mechanisms of Earthquakes

Theory and Practice



By A. Udías, R. Madariaga, E. Buforn

CAMBRIDGE UNIVERSITY PRESS

311 pages | Hardback
1st edition | April 2014
ISBN 9781107040274

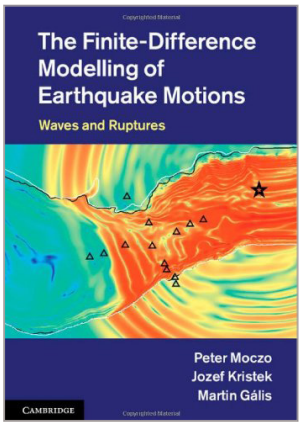
Price: £45 (~€57)

Publisher's summary

This book presents an innovative new approach to studying source mechanisms of earthquakes, combining theory and observation in a unified methodology, with a key focus on the mechanics governing fault failures. It explains source mechanisms by building from fundamental concepts such as the equations of elasticity theory to more advanced problems including dislocation theory, kinematic models and fracture dynamics. The theory is presented first in student-friendly form using consistent notation throughout, and with full, detailed mathematical derivations that enable students to follow each step. Later chapters explain the widely-used practical modelling methods for source mechanism determination, linking clearly to the theoretical foundations, and highlighting the processing of digital seismological data. Providing a unique balance between application techniques and theory, this is an ideal guide for graduate students and researchers in seismology, tectonophysics, geodynamics and geomechanics, and a valuable practical resource for professionals working in seismic hazard assessment and seismic engineering.

Book review: The Finite-Difference Modelling of Earthquake Motions

Waves and Ruptures



By P. Moczo, J. Kristek, M. Gális

CAMBRIDGE UNIVERSITY PRESS

383 pages | Hardback
1st edition | April 2014
ISBN 9781107028814

Price: £75 (~€95)

Numerical modelling plays a major role in many modern scientific branches. Accurate methods combined with detailed models give the possibility to scientists to test their hypotheses. In seismology, the need of sophisticated wave propagation tools started to grow a while ago to narrow the gap between observation and theory. Despite all the approximate methods already available at the time, seismologists started to generate synthetic seismograms extensively by using numerical methods in the seventies. Synthetic waveforms, in contrast with real waveforms recorded by seismometers, are generated on Earth models providing a suitable method to test scientists' predictions. Soon, numerical methods found their way to a wide range of topics from local to global seismology and the new methods started to emerge in order to enhance the modelling accuracy and efficiency.

Among all the numerical methods, maybe the Finite Difference Method (FDM) is the most convenient one to start with due to its simple approach: taking differences from the neighboring points. Albeit simple, there are many challenges arising to adapt this method for different applications such as earthquake ground motion.

The Finite-Difference Modelling of Earthquake Motions, Waves and Ruptures, by Peter Mocza, Jozef Kristek and Martin Gális, is the first book that provides seismologists with a comprehensive introduction to FDM by explaining the method and its applications in earthquake motion. Its main target audiences are academic researchers and graduate students in seismology and geophysics who want to get familiar with numerical seismological techniques. Yet, it is a good reference for those who are familiar with the method but want to learn the details in applying numerical methods to real problems.

The eminent board of authors has a long history in developing and applying Finite-Difference (FD) and hybrid Finite-Difference-Finite-Element methods in seismology. It is clear that a good effort was put into collecting some of their major contributions in the book, which resulted in well written chapters with informative figures. It covers the basics required to understand the method combined with detailed derivations of the equations and advanced examples. Maybe one of the main features of the book is its systematic sectioning, making it easy for the reader to refer to the desired section.

In Part I, the reader gets familiar with the governing equations, the equation of motion and the constitutive law of different media, in the forms usable for FD schemes with an overview over different initial/boundary conditions. These are followed by detailed explanations and formulations of rheological models of a continuum media. The chapter finishes with a comprehensive description on earthquake sources.

The numerical part of the book matures in Part II. After an overview on different numerical methods in solving seismological equations, the authors introduce FDM and explain the basic properties of this method. This consists of spatial FD grids, derivation of the equations and time schemes. An instructive section in this chapter is the application of the FD to the 1D problem, avoiding any complications introduced by three-dimensional domains. However, this has been treated later in this part by explaining the method in 3D media. In all these sections, special attention is given to the accuracy, error analysis and stability of the method as well.

The book goes one step further than pure FDM, and it explains the Finite Element (FE) method, in which the boundary conditions at the free surface can be more easily incorporated. Afterwards, the authors explain a method that combines the advantages of FE and FD in the form of a hybrid FD–FE method.

In the last part, the method is applied to a realistic scenario: modelling of earthquake motion in the Mygdonian basin. This chapter gives a good overview on verification and validation to evaluate the accuracy and reliability of numerical methods in a real example.

One of the remarkable aspects of this book is its usability for a wide range of audience. It has a smooth approach in developing and explaining the required ingredients to introduce and apply the method. In each section, a list of references is provided for further reading in the topic. It covers a variety of challenges that seismologists encounter in using and choosing the convenient forward modelling codes for their applications. Moreover, the book tries to cover lots of topics scattered in different research articles in one book and explains them in a concise way. This is indeed an advantage; however, in some sections, the details can go beyond the patience of non-experienced readers. This can be easily avoided by carefully

selecting the relevant and more general sections for those who do not want to go through all the details.

All in all, The Finite-Difference Modelling of Earthquake Motions, Waves and Ruptures is an excellent book for starting, as well as broadening the knowledge, in numerical seismological techniques. It covers not only the main aspects of computational methods, and in particular FDM, but also familiarises the readers with the applications of the method for more advanced seismological problems.

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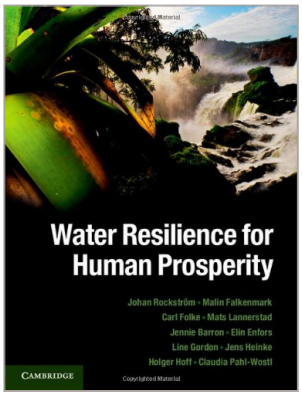
Book review: Water Resilience for Human Prosperity



By J. Rockström, M. Falkenmark, C. Folke, M. Lannerstad, J. Barron, E. Enfors, L. Gordon, J. Heinke, H. Hoff, C. Pahl-Wostl

CAMBRIDGE UNIVERSITY PRESS

311 pages | Hardback
1st edition | March 2014
ISBN 9781107024199

Price: £45 (~€57)

The concept of ecological resilience – persistence of a system through change – was introduced by the Canadian ecologist C.S. Holling in 1973. Now, over 40 years later, Water Resilience for Human Prosperity sets an ambitious goal by tackling the world's key resource in the spotlight of global change. While the book's title suggests a focus on the resilience of water resources, Rockström et al. clarify that it rather deals with the role of water in sustainable development. Thus, it addresses students, researchers, planners and decision makers; in short: everyone playing a direct or indirect role on the Earth's ecological path for the future. However, it should be said that it is more of a well-rounded textbook than a how-to guide if you are in an executive position.

The book, written by Sweden- and Germany-based researchers, is separated into nine chapters and includes up-to-date scientific references and excellent figures. The examples are manifold and relevant for practical applications: for instance, two invited authors analyse and compare the socio-economic consequences of groundwater extraction in the plains of China and North America. A summary closes every chapter and key terms are defined in a glossary. The global-level maps and graphs provide the reader with a detailed impression of where our water and sustainability problems are located. All this said, Water Resilience for Human Prosperity is a densely written volume that comes along a bit theoretical at times, but is generally tangible for the reader.

Starting with a thorough look at the role of water in the biosphere, the book then moves to human alterations of the water cycle and the complex socio-economic interrelations connected to them. On the way, it addresses today's urgent issues such as climate change, land conversion and the growth of population which, for themselves, may be worth looking into. Processes are linked from the local to the global scale and across the gap between ecology and economy. Finally, the volume offers approaches on how the resulting new dynamics can be managed.

A thematic focus is put on food production. The reason for this is a required 70% increase in production to feed the expected population in 2050, combined with the fact that water is the limiting resource for food production in many strong-growing countries. Additionally, the authors devote an extra chapter to the savannah zone, as it represents 30% of land area and population and has high agro-hydrological potential, which suggests the possibility of more than doubling the yield from farming in the future.

What I appreciated most about the book is that it does not simply collect, point out and link sustainability issues around the world, but names and explains strategies to increase water and food resilience, such as a functioning global food trade, the increase of food stocks and diet change towards a greater share of plant-based calorie intake. It is, however, realistic by admitting the challenges and limits of the various approaches.

Overall, this isn't a book you would bring on a holiday; reading Water Resilience for Human Prosperity is hard but fruitful work given how informative the volume is. If you haven't worked on water, it's a great interdisciplinary and contemporary introduction to it. If you're a hydrologist, you may still find it a valuable read, because it comprises the global, socio-economic and complex perspective of today's changing world.

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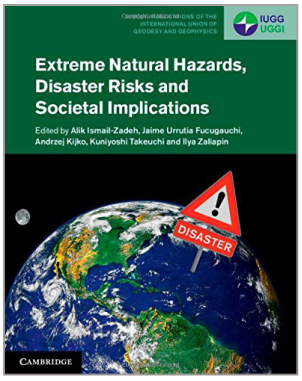
BACK TO CONTENTS

Book review: Extreme Natural Hazards, Disaster Risks and Societal Implications



Edited by A. Ismail-Zadeh, J. U. Fucugauchi, A. Kijko, K. Takeuchi, I. Zaliapin

CAMBRIDGE UNIVERSITY PRESS

413 pages | Hardback
1st edition | April 2014
ISBN 9781107033863

Price: £90 (~€114)

This volume presents a unique and interdisciplinary approach to disaster risk research, combining natural and social science on a global scale. It comprises 30 peer-reviewed chapters with contributions from 58 authors, edited by experts from around the world.

The editors are Alik Ismail-Zadeh (Karlsruhe Institute of Technology), Jaime Urrutia Fucugauchi (Universidad Nacional Autonoma de Mexico), Andrzej Kijko (University of Pretoria Natural Hazard Centre), Kuniyoshi Takeuchi (UNESCO), and Ilya Zaliapin (University of Nevada). All work actively within the field of natural hazards and risk management, and the book itself is an extension of the topics covered at the Extreme Natural Hazards and Societal Implications (ENHANS) international meetings between 2010 and 2011.

The stated main audience for this book are researchers in academia and grad students, with a secondary audience of policymakers and disaster prevention specialists, making the scope wide but with the sense that technicalities may be discussed.

The book layout begins with an introduction and review of natural hazards in general. This segment also covers the book's origins as part of the ENHANS project.

Each chapter of part two focuses on a particular hazard or technology for dealing with a hazard, and holds some of the most technical text in the volume. The book alleges to have covered every type of big natural disaster, although personally I feel they could have given some attention to extraterrestrial impacts, which are not discussed at all. There was, however, a very interesting chapter on space weather, which has clear implications for our technology-dependent world and should be discussed more outside of this text.

The four subsequent parts, from three through to six, each focus on different regions of the world: Latin America and the Caribbean, Africa, the Middle East, and Asia and the Pacific. These regions were chosen purposely as they contain a higher level of risk in relation to extreme natural hazards due to their high populations, number of developing nations, and in many areas a lack of extensive research compared to areas like Europe and North America.

These parts are comprised entirely of case studies, all very statistics-heavy, relating to discrete incidents. The whole section reads like a complete and separate case study volume, designed to give one an idea of what is and isn't possible when it comes to extreme hazards in these areas. Through it, some interesting data come out, such as the fact that Africa is so plagued by hydro-meteorological hazards that earthquakes, landslides and volcanoes only contribute to 2% of the total hazard risk – something that greatly influences policy time given towards these potentially damaging hazards in some African nations. Or the fact that many Mexican volcanoes still lack data on magma genesis, ascent and trigger mechanisms, a worrying fact for a country that has large populations living within kilometres from more than a dozen active volcanoes.

Throughout these chapters, their authors also take pains to explain and consolidate the reader's understanding of terminology, such as the differences of a hazard (a dangerous phenomenon that may cause loss) and of risk (a measure that characterises those losses resulting from a hazard). Emphasis on explaining risk mitigation as more than just an emergency response but as something that comprises of preparation in terms of policymaking, and prevention in terms of land-use planning, is noticeable throughout the volume, and this gives the volume a very responsible credence.

Part seven, on disaster risk and societal implications, was the stand-out section of the volume, and made for the most interesting and useful reading. It necessitates the prior case studies and general overviews of types of hazard in order to lend gravity to the situation, particularly for policymakers reading the text.

This final section also makes it apparent that the book is very timely indeed. The Millennium Development Goals are to be adopted in 2015 during the next World Conference on Disaster Reduction, and this book's creed seems to be to encourage people to improve the relationship between risk reduction and land-use development at the national level, and to change the fatalistic belief in policymaking that such disasters are inevitable and thus loss is unavoidable.

There are lots of progressive ideas towards the end concerning the combination of disaster policy with climate change, sea-level rise, insurance and poverty. All are key issues that are only going to become more important in the coming decades.

In all the text is not very technical. It can be read and understood by a vast majority readership – which is perfect for a book that espouses reducing barriers to knowledge in order to improve risk mitigation.

This book is an enlightening read for anyone interested in the subject of natural hazards, and is a must for anyone involved in policy, decision-making, or scientific research in this field.

Holly Ferrie
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