Self Organized Criticality In Astrophysics The Statistics Of Nonlinear Processes In The Universe Springer Praxis Books

An overview of results and methods, written for graduates and researchers in physics, mathematics, biology, sociology, finance, medicine and engineering. The two-volume book Gravitational Waves provides a comprehensive and detailed account of the physics of gravitational waves. While Volume 1 is devoted to the theory and experiments, Volume 2 discusses what can be learned from gravitational waves in astrophysics and in cosmology, by systematizing a large body of theoretical developments that have taken place over the last decades. The second volume also includes a detailed discussion of the first direct detections of gravitational waves. In the author's typical style, the theoretical results are generally derived afresh, clarifying or streamlining the existing derivations whenever possible, and providing a coherent and consistent picture of the field. The first volume of Gravitational Waves , which appeared in 2007, has established itself as the standard reference in the field. The scientific community has eagerly awaited this second volume. The recent direct detection

of gravitational waves makes the topics in this book particularly timely.
To many scientists the gap between the nineteenth century views of consciousness proposed by the psychologist William James and that developed by the inventor of psychophysics Gustav Fechner has never seemed wider. However the twentieth century concept of collective/cooperative behavior within the brain has partially reconciled these diverging perspectives suggesting the notion of consciousness as a physical phenomenon. A kernel of twenty-first century investigators bases their investigations on physiological fluctuations experiments. These fluctuations, although apparently erratic, when analyzed with advanced methods of fractal statistical analysis reveal the emergence of complex behavior, intermediate between complete order and total randomness, a property usually referred to as temporal complexity. Others, with the help of modern technologies, such MRI, establish a more direct analysis of brain dynamics, and focus on the brain's topological complexity. Consequently the two groups adopt different approaches, the former being based on phenomenological and macroscopic considerations, and the latter resting on the crucial role of neuron interactions. The neurophysiology research work has an increasing overlap with the emerging field of complex networks, whereas the behavior psychology experiments have until recently ignored the complex cooperative dynamics that

are proved by increasing experimental evidence to characterize the brain function. It is crucial to examine both the experimental and theoretical studies that support and those that challenge the view that it is an emergent collective property that allows the healthy brain to function. What needs to be discussed are new ways to understand the transport of information through complex networks sharing the same dynamical properties as the brain. In addition we need to understand information transfer between complex networks, say between the brain and a controlled experimental stimulus. Experiments suggest that brain excitation is described by inverse power-law distributions and recent studies in network dynamics indicate that this distribution is the result of phase transitions due to neuron network dynamics. It is important to stress that the development of dynamic networking establishes a connection between topological and temporal complexity, establishing that a scale-free distribution of links is generated by the dynamic correlation between dynamic elements located at very large Euclidean distances from one another. Dynamic networking and dynamics networks suggest a new way to transfer information: the long-distance communication through local cooperative interaction. It is anticipated that the contributed discussions will clarify how the global intelligence of a complex network emerges from the local cooperation of units and the role played by critical phase

transitions in the observed persistence of this cooperation.

Many approaches exist for scientific investigations and space research is no exception. The early approach during which each space plasma region within the Sun-Earth system was investigated separately with physics-based tools has now progressed to encompass investigations on coupling between these regions. Ample evidence now exists indicating the dynamic processes in these regions exhibit disturbances over a wide range of scales both in time and space. This new reckoning naturally leads to an emerging perspective of probing these natural phenomena with concepts and tools developed in modern statistical mechanics for physical processes governing the evolution of out-of-equilibrium and complex systems. These new developments have prompted a topical conference on Sun-Earth connection, held on February 9-13, 2004 at Kailua-Kona, Hawaii, USA, with the goal of promoting interactions among scientists practicing the traditional physics-based approach and those utilizing modern statistical techniques. This monograph is a product of this conference, a compilation of thirty-nine articles assembled into seven chapters: (1) multiscale features in complexity dynamics, (2) space storms, (3) magnetospheric substorms, (4) turbulence and magnetic reconnection, (5) modeling and coupling of space phenomena, (6) techniques for multiscale space plasma problems, and

(7) present and future multiscale space missions. These articles show a diversity of space phenomena exhibiting scale free characteristics, intermittency, and non-Gaussian distributions of probability density function of fluctuations in the physical parameters of the Sun-Earth system. The scope covers the latest observations, theories, simulations, and techniques on the multiscale nature of Sun-Earth phenomena and underscores the usefulness in cross-disciplinary exchange needed to unravel the underlying physical processes, which may eventually lead to a possible unified description and prediction for space disturbances. * Extensive collection of state-of-the-art papers on multiscale coupling of Sun-Earth Processes * Present and future multiscale space missions * New techniques and models for performing multiscale analysis

This book provides a short, hands-on introduction to the science of complexity using simple computational models of natural complex systems—with models and exercises drawn from physics, chemistry, geology, and biology. By working through the models and engaging in additional computational explorations suggested at the end of each chapter, readers very quickly develop an understanding of how complex structures and behaviors can emerge in natural phenomena as diverse as avalanches, forest fires, earthquakes, chemical reactions, animal flocks, and epidemic diseases. Natural Complexity provides the

necessary topical background, complete source codes in Python, and detailed explanations for all computational models. Ideal for undergraduates, beginning graduate students, and researchers in the physical and natural sciences, this unique handbook requires no advanced mathematical knowledge or programming skills and is suitable for self-learners with a working knowledge of precalculus and high-school physics. Self-contained and accessible, Natural Complexity enables readers to identify and quantify common underlying structural and dynamical patterns shared by the various systems and phenomena it examines, so that they can form their own answers to the questions of what natural complexity is and how it arises.

Networks of Echoes: Imitation, Innovation and Invisible Leaders is a mathematically rigorous and data rich book on a fascinating area of the science and engineering of social webs. There are hundreds of complex network phenomena whose statistical properties are described by inverse power laws. The phenomena of interest are not arcane events that we encounter only fleetingly, but are events that dominate our lives. We examine how this intermittent statistical behavior intertwines itself with what appears to be the organized activity of social groups. The book is structured as answers to a sequence of questions such as: How are decisions reached in elections and

boardrooms? How is the stability of a society undermined by zealots and committed minorities and how is that stability re-established? Can we learn to answer such questions about human behavior by studying the way flocks of birds retain their formation when eluding a predator? These questions and others are answered using a generic model of a complex dynamic network—one whose global behavior is determined by a symmetric interaction among individuals based on social imitation. The complexity of the network is manifest in time series resulting from self-organized critical dynamics that have divergent first and second moments, are non-stationary, non-ergodic and non-Poisson. How phase transitions in the network dynamics influence such activity as decision making is a fascinating story and provides a context for introducing many of the mathematical ideas necessary for understanding complex networks in general. The decision making model (DMM) is selected to emphasize that there are features of complex webs that supersede specific mechanisms and need to be understood from a general perspective. This insightful overview of recent tools and their uses may serve as an introduction and curriculum guide in related courses.

A clear and concise introduction to this new, cross-disciplinary field.

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Stellar astrophysics still provides the basic framework for deciphering the imprints left over by the evolving universe on all scales. Advances or shortcomings in the former field have direct consequences in our ability to understand the global properties of the latter. This volume contains the most recent updates on a variety of topics that, though independent by themselves, are inevitably connected on a cosmological scale. These include comprehensive articles by leaders in fields extending from stellar atmospheres through properties of the stellar component in the Milky Way up to the stellar environment in high redshift galaxies. The wide coverage of astrophysical themes makes this volume very valuable for researchers and Ph.D. students in astrophysics.

This book presents a new concept of General Systems Theory and its application to atmospheric physics. It reveals that energy input into the atmospheric eddy continuum, whether natural or manmade, results in enhancement of fluctuations of all scales, manifested immediately in the intensification of high-frequency fluctuations such as the Quasi-Biennial Oscillation and the El-Nino–Southern Oscillation cycles. Atmospheric flows exhibit self-organised criticality, i.e. long-range correlations in space and time manifested as fractal geometry to the spatial pattern concomitant with an inverse power law form for fluctuations of meteorological parameters such as temperature, pressure etc. Traditional meteorological theory cannot satisfactorily explain the observed self-similar space time structure of atmospheric flows. A recently developed general systems theory for fractal space-time fluctuations shows that the larger-scale fluctuation can be visualised to emerge from the space-time averaging of enclosed small-scale fluctuations, thereby generating a hierarchy of self-similar fluctuations manifested as the observed eddy continuum in power spectral analyses of

fractal fluctuations. The interconnected network of eddy circulations responds as a unified whole to local perturbations such as global-scale response to El-Nino events. The general systems theory model predicts an inverse power law form incorporating the golden mean ? for the distribution of space-time fluctuation patterns and for the power (variance) spectra of the fluctuations. Since the probability distributions of amplitude and variance are the same, atmospheric flows exhibit quantumlike chaos. Long-range correlations inherent to power law distributions of fluctuations are identified as nonlocal connection or entanglement exhibited by quantum systems such as electrons or photons. The predicted distribution is close to the Gaussian distribution for small-scale fluctuations, but exhibits a fat long tail for large-scale fluctuations. Universal inverse power law for fractal fluctuations rules out unambiguously linear secular trends in climate parameters.

Instabilities are present in all natural fluids from rivers to atmospheres. This book considers the physical processes that generate instability. Part I describes the normal mode instabilities most important in geophysical applications, including convection, shear instability and baroclinic instability. Classical analytical approaches are covered, while also emphasising numerical methods, mechanisms such as internal wave resonance, and simple `rules of thumb' that permit assessment of instability quickly and intuitively. Part II introduces the cutting edge: nonmodal instabilities, the relationship between instability and turbulence, self-organised criticality, and advanced numerical techniques. Featuring numerous exercises and projects, the book is ideal for advanced students and researchers wishing to understand flow instability and apply it to their own research. It can be used to teach courses in oceanography, atmospheric science, coastal engineering, applied mathematics and environmental science.

Exercise solutions and MATLAB® examples are provided online. Also available as Open Access on Cambridge Core.

A primer for researchers and graduate students; introduces and applies chaos techniques to specific astrophysical systems.

This book presents studies of complexity in the context of nonequilibrium phenomena using theory, modeling, simulations, and experiments, both in the laboratory and in nature.

This book provides a survey of the basic ideas of the cellular automaton (CA) modelling environment, emphasising the relevance of this framework to astrophysical applications. It contains introductory level lectures on lattice gases, and on CA turbulence, diffusion-reaction processes, percolation and self-organised criticality. Further, it gives a variety of astrophysical applications, including stellar oscillations, galactic evolution, distribution of luminous matter in the universe, etc.

Describes gamma-ray bursts and the mysteries surrounding them.

The purpose of this book is to illustrate the fundamental concepts of complexity and complex behavior and the best methods to characterize this behavior by means of their applications to some current research topics from within the fields of fusion, earth and solar plasmas. In this sense, it is a departure from the many books already available that discuss general features of complexity. The book is divided in two parts. In the first part the most important properties and features of complex systems are introduced, discussed and illustrated. The second part discusses several instances of possible complex phenomena in magnetized plasmas and some of the analysis tools that were introduced in the first part are used to characterize the dynamics in these systems. A list of problems is proposed at the end of each chapter. This

book is intended for graduate and post-graduate students with a solid college background in mathematics and classical physics, who intend to work in the field of plasma physics and, in particular, plasma turbulence. It will also be of interest to senior scientists who have so far approached these systems and problems from a different perspective and want a new fresh angle.

Chance discovery means discovering chances - the breaking points in systems, the marketing windows in business, etc. It involves determining the significance of some piece of information about an event and then using this new knowledge in decision making. The techniques developed combine data mining methods for finding rare but important events with knowledge management, groupware, and social psychology. The reader will find many applications, such as finding information on the Internet, recognizing changes in customer behavior, detecting the first signs of an imminent earthquake, etc. This first book dedicated to chance discovery covers the state of the art in the theory and methods and examines typical scenarios, and it thus appeals to researchers working on new techniques and algorithms and also to professionals dealing with real-world applications.

Dark matter and dark energy are one of the central mysteries in modern physics, although modern astrophysical and cosmological observations and particle physics experiments can and will provide vital clues in uncovering its true nature. The DARK 2009 Conference brought together World?s leading researchers in both astrophysics and particle physics, providing an opportunity and platform to present their latest results to the community. The topics covered are wide-ranging, from terrestrial underground experiments to space experimental efforts to search for dark matter, and on the theoretical aspects, from the generating of a fifth family as

origin of dark matter, extra dimensions and dark matter to non-standard Wigner classes and dark matter. One of the new highlights was certainly a possible connection between a neutrino mass as observed by nuclear double beta decay and the dark energy. Highly important and relevant in its field, the book presents a vital snapshot of the sometimes seemingly disparate areas of dark matter research and offers an exciting overview of current ideas and future directions.

This book consists of about 20 lectures on theoretical and observational aspects of astrophysical black holes, by experts in the field. The basic principles and astrophysical applications of the black hole magnetosphere and the Blandford–Znajek process are reviewed in detail, as well as accretion by black holes, black hole X-Ray binaries, black holes with cosmic strings, and so on. Recent advances in X-Ray observations of galactic black holes and new understanding of supermassive black holes in AGNs and normal galaxies are also discussed. Contents: Black Hole ObservationsBlack Hole and SpacetimesBlack Hole MagnetosphereBlack Hole AccretionSupermassive Black HolesGamma-ray BurstsNumerical Relativity Readership: Graduate students and researchers in astrophysics, astronomy, cosmology and theoretical physics. Keywords:

Much work has been done on trying to gain insight into the dynamics of accreting systems, such as black hole and neutron star binaries, by analyzing timing measurements from X-ray telescopes. In this thesis we present a novel approach to this problem using a kurtosis measure of the wavelet distribution obtained from the light curve to quantify the presence of intermittent activity. This method is applied to large RXTE data sets for GRS 1915+105, and Cygnus X-1. We demonstrate a new approach to reveal bursting modes. Negative correlation

between the presence of a low frequency QPO in the Cygnus X-1 Fourier power spectrum and a wavelet kurtosis indicator of temporal intermittency is observed. A possible interpretation of this anti-correlation is developed using a "dripping handrail" transient chaos model.

The Pacific Rim Conference originally started with one research concentration only - binary star research. The first Conference was held in Beijing, China, 1985, the second one in Seoul and Taejon, South Korea, 1990 and the third one in Chiang Mai, Thailand, 1995. In recent years, the conference series evolved into a much broader area of stellar astrophysics. The first such conference was held in Hong Kong in 1997. Kwong-Sang Cheng, a. k. a. one of the three Musketeers, documented the "accidental" development in writing in the Proceedings of the 1997 Pacific Rim Conference on Stellar Astrophysics (Volume 138 of the ASP Conference Series)! The meeting at Hong Kong University of Science and Technology covered three major topics: binary stars, compact stars and solar type stars. The conference was extremely successful. There was a general feeling among the participants that the conference on stellar astrophysics provided a good means to share ideas between such closely related disciplines. Unfortunately after the very successful meeting at HKST, Kwing L. Chan (another Musketeer) thought that he had already served and would not like to chair for another LOC for at least five years! After a few drinks at one of the watering holes in Wan Chai district of Hong Kong, Kwong-Sang Cheng was in very hiRh spirit and volunteered to taking on the responsibility of hosting the 51 Pacific Rim Conference at Hong Kong University in 1999.

Self-organized criticality, the spontaneous development of systems to a critical state, is the first general theory of complex systems with a firm mathematical basis. This theory describes how many seemingly desperate aspects of the world, from stock market crashes to mass

extinctions, avalanches to solar flares, all share a set of simple, easily described properties. "...a'must read'...Bak writes with such ease and lucidity, and his ideas are so intriguing...essential reading for those interested in complex systems...it will reward a sufficiently skeptical reader." -NATURE "...presents the theory (self-organized criticality) in a form easily absorbed by the non-mathematically inclined reader." -BOSTON BOOK REVIEW "I picture Bak as a kind of scientific musketeer; flamboyant, touchy, full of swagger and ready to join every fray... His book is written with panache. The style is brisk, the content stimulating. I recommend it as a bracing experience." -NEW SCIENTIST

Markus Aschwanden introduces the concept of self-organized criticality (SOC) and shows that due to its universality and ubiquity it is a law of nature for which he derives the theoretical framework and specific physical models in this book. He begins by providing an overview of the many diverse phenomena in nature which may be attributed to SOC behaviour. The author then introduces the classic lattice-based SOC models that may be explored using numerical computer simulations. These simulations require an in-depth knowledge of a wide range of mathematical techniques which the author introduces and describes in subsequent chapters. These include the statistics of random processes, time series analysis, time scale distributions, and waiting time distributions. Such mathematical techniques are needed to model and understand the power-law-like occurrence frequency distributions of SOC phenomena. Finally, the author discusses fractal geometry and scaling laws before looking at a range of physical SOC models which may be applicable in various aspects of astrophysics. Problems, solutions and a glossary will enhance the pedagogical usefulness of the book. SOC has been receiving growing attention in the astrophysical and solar physics community. This book will be

welcomed by students and researchers studying complex critical phenomena.

The Journal on Advanced Studies in Theoretical and Experimental Physics, including Related Themes from Mathematics

In May 1998 a hundred renowned scientists from 20 different countries met at the Max-Planck-Institut für Aeronomie to communicate their latest results and ideas in astrophysical and space plasma, as a follow-up to previous similar meetings which were held in Varenna, Abastumai, Potsdam, Toki and Guaruja. The main papers emerging from this meeting are collected in this volume. They deal with fundamental plasma phenomena, particle and radiation processes in astrophysics and space physics as the origin of magnetic activity, the basic mechanisms of particle acceleration and plasma heating common to plasma in galaxies and at the sun as well as in planetary magnetospheres. New observational results from YOHKOH, SOHO and other missions are presented. Using these, the basic physical processes leading to coronal heating and solar/stellar wind acceleration are discussed. Other topics are the microphysics of shock waves and transport phenomena in collisionless plasmas and the physics of thin plasma boundaries. The volume also treats the ionic composition of plasma and dust in the Universe and their observability in the solar system. A CD-ROM is attached which adds a valuable multimedia component, illuminating results of observations, theory and simulations. Everyone interested in astrophysical plasmas, its radiation and charged particle aspects, and advanced or even beginning students will find references to nearly all modern aspects of plasma astrophysics and space physics as well as an overview of current research results.

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have built Issues in Astronomy and Astrophysics: 2013 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Planetary Science 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 Astronomy and Astrophysics: 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.ScholarlyEditions.com/.

This book contains the proceedings of the Fifth International Conference on Physics Beyond the Standard Models of Particle Physics, Cosmology and Astrophysics. It presents a brilliant overview of the status and future potential and trends in experimental

This is a follow-on book to the introductory textbook "Physics of the Solar Corona" previously published in 2004 by the same author, which provided a systematic introduction and covered mostly scientific results from the pre-2000 era. Using a similar structure as the previous book the second volume provides a seamless continuation of numerous novel research results in solar physics that emerged in the new millennium (after 2000) from the new solar missions of RHESSI, STEREO, Hinode, CORONAS, and the Solar Dynamics Observatory (SDO) during the era of 2000-2018. The new solar space missions are characterized by unprecedented high-resolution imaging, time resolution, spectral capabilities, stereoscopy and tomography, which reveal the intricate dynamics of magneto-hydrodynamic processes in the solar corona down to scales of 100 km. The enormous amount of data streaming down from SDO in Terabytes per

day requires advanced automated data processing methods. The book focuses exclusively on new research results after 2000, which are reviewed in a comprehensive manner, documented by over 3600 literature references, covering theory, observations, and numerical modeling of basic physical processes that are observed in high-temperature plasmas of the Sun and other astrophysical objects, such as plasma instabilities, coronal heating, magnetic reconnection processes, coronal mass ejections, plasma waves and oscillations, or particle acceleration.
Presents recent findings on charged cosmic rays, primarily nuclei, from galactic and extra-galactic sources. Chapters on new and proposed instruments and techniques examine projects such as the SilEye and the PAMELA apparatus for the search of antimatter in cosmic rays. Papers on cosmic ray models look at nonlinear phenomena in diffusive shock acceleration, and propagation of cosmic rays in the galaxy. Material on cosmic ray sources and ultra-high energy cosmic rays examine source composition and its relation to the interstellar matter, and cosmic ray mass composition at highest energies. The editor is a researcher at Pennsylvania State University. Annotation copyrighted by Book News, Inc., Portland, OR
This book contains the peer-reviewed papers presented at the Sixth Annual International Astrophysics Conference. This conference brought together a range of topics that shed light on our understanding and status of turbulence and nonlinear processes in astrophysical plasmas. Coverage in this volume includes turbulent relaxation in laboratory and space plasmas and its application to coronal flux tubes, coronal heating, and the diffusion of energetic particles.
The year 2005, which marked the 100th anniversary of the 'annus mirabilis', the year in which Albert Einstein published three of his most important scientific papers, was the perfect opportunity to review and to present the current scientific understanding of relativistic topics.

This book provides an up-to-date reference on the theory of gravity, relativistic astrophysics and cosmology. It is a useful reference tool for both the expert and the new-comer in these fields.

This book provides a short, hands-on introduction to the science of complexity using simple computational models of natural complex systems--with models and exercises drawn from physics, chemistry, geology, and biology. By working through the models and engaging in additional computational explorations suggested at the end of each chapter, readers very quickly develop an understanding of how complex structures and behaviors can emerge in natural phenomena as diverse as avalanches, forest fires, earthquakes, chemical reactions, animal flocks, and epidemic diseases. Natural Complexity provides the necessary topical background, complete source codes in Python, and detailed explanations for all computational models. Ideal for undergraduates, beginning graduate students, and researchers in the physical and natural sciences, this unique handbook requires no advanced mathematical knowledge or programming skills and is suitable for self-learners with a working knowledge of precalculus and high-school physics. Self-contained and accessible, Natural Complexity enables readers to identify and quantify common underlying structural and dynamical patterns shared by the various systems and phenomena it examines, so that they can form their own answers to the questions of what natural complexity is and how it arises.

The perception of time is crucial for everyday activities from the sleep–wake cycle to playing and appreciating music, verbal communication, to the determination of the value of a particular behavior. With regard to the last point, making decisions

is heavily influenced by the duration of the various options, the duration of the expected delays for receiving the options, and the time constraints for making a choice. Recent advances suggest that the brain represents time in a distributed manner and reflects time as a result of temporal changes in network states and/or by the coincidence detection of the phase of different neural populations. Moreover, intrinsic oscillatory properties of neural circuits could determine timed motor responses. This Research Topic, partly an emergence of a Satellite EBBS meeting sponsored by the COST-Action TIMELY, will discuss how time in the physical world is reconstructed, distorted and modified in brain networks by emotion, learning and neuropathology. This Research Topic on Timing contains up-to-date reviews regarding the relationship between time and decision-making with respect to the underlying psychological and physiological mechanisms responsible for anticipation and evaluation processes.

These are the proceedings of the Symposium 3 of JENAM 2011 on new scientific challenges posed by the Sun. The topics covered are 1. The unusual sunspot minimum, which poses challenges to the solar dynamo theory 2. The Sun's Terra-Hertz emission, which opens a new observational window 3. Corona wave activity 4. Space weather agents - initiation, propagation, and forecasting In 21 in-depth contributions, the reader will be presented with the latest findings.

Flocks of birds, schools of fish and swarms of locusts display amazing forms of collective motion, while huge numbers of glow worms can emit light signals with almost unbelievable synchronization. These and many other collective phenomena in animal societies take place according to laws very similar to those governing the collective behavior in the inanimate nature, such as the magnetization of iron and the light radiation of lasers. During recent years, this has led to the study of swarm behavior as a challenging new field of science, in which ideas from the physical world are applied in order to understand the formation and structure of animal swarms. From these studies, it has become clear that such collective behavior of animals emerges in a self-organized way, without any need of overall coordination. In this book, we present different swarm phenomena of the animal world and compare them to their counterparts in physics, in a conceptual and non-technical way, addressed to a general readership.

On the basis of a total of thirteen case examples from the Tien Shan, Karakorum, Himalaya and Tangula Shan (central Tibet), the risk potential and hazards are inferred from the development of landscape during the Quaternary. The history of glaciers can be seen as of central importance for this. The Ice Age glacial erosion created V-shaped valleys, which with their steep flanks - as a consequence of the

interglacial formation of V -valleys - have prepared and brought about landslides as well as rockslides and the hazards, combined with them. The same is true for the moraines, which the gla ciers have deposited high-up in the valley flanks and related loose stone deposits. Dry and wet mass movements follow after heavy precipitation, especially in the semi-arid investigation areas, and are catastrophes for the settlements and the communication routes in the valley floors. Their key-forms are debris cones and debris slopes, as well as mudflows and alluvial fans. In addition to the Ice Age glaciation history, as a preparatory, indirect factor, the Holocene to present glaciation history is, as a result of the danlming-up of glacier- and moraine lakes and their outbursts, a direct risk factor. The examples presented of acute and already occurred cases of damage were inves tigated in the years 1989-1994. Acknowledgements The authors wish to thank the Deutsche Forschungsgemeinschaft (DFG), the Max Planck-Gesellschaft (MPG), the Volkswagen-Stiftting (VW) and the Deutscher Aka demischer Austauschdienst (DAAD) for the financial support for the field-work.