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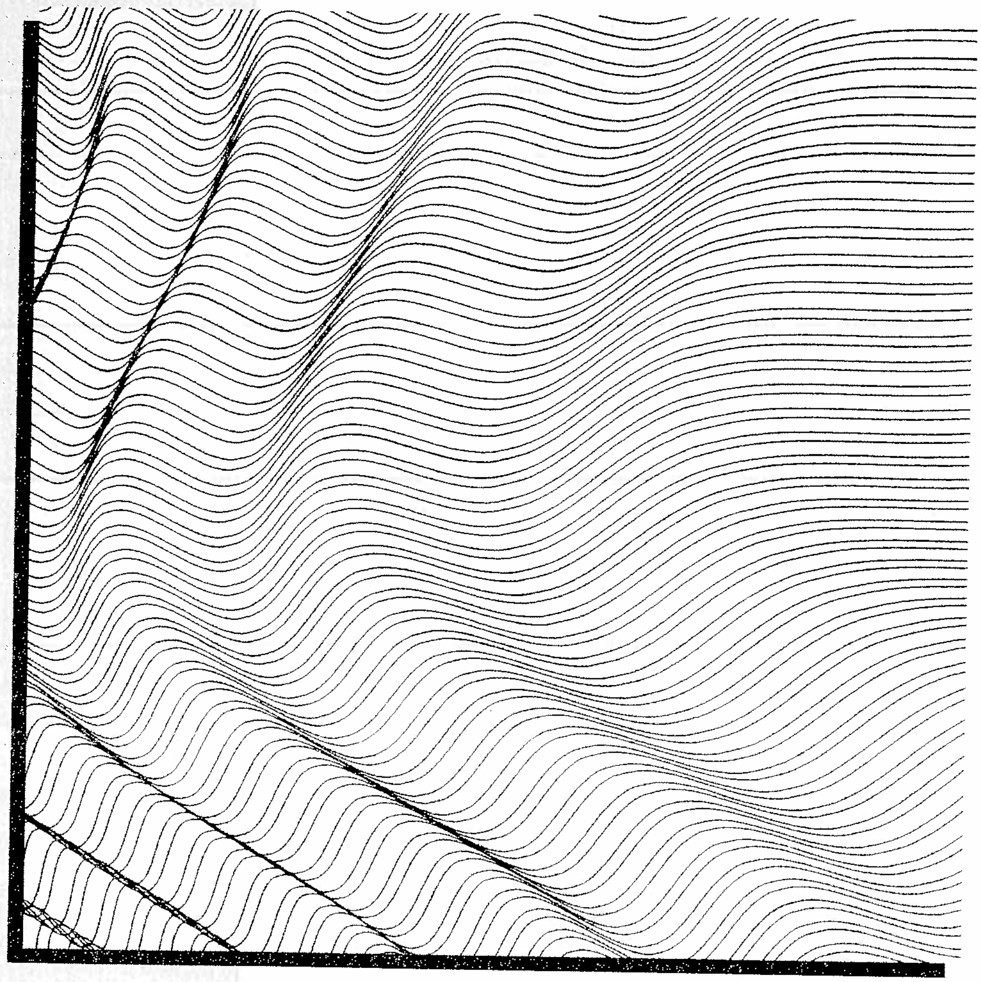

N. 2

Istituto Nazionale di Oceanografia e di Geofisica Sperimentale

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Unload Response Ratio and the indications of Critical Sensitivity, Accelerated Moment or Energy Release before a catastrophic rupture.

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S. Hergarten
SELF-ORGANIZED CRITICALITY IN EARTH SYSTEMS
Springer Verlag, Berlin Heidelberg
2002, 272 pp., hard cover
ISBN 3-540-43452-6
69.95 €, 49.00 £, 116.50 sFr, 69.95 $

By a strange coincidence, this book, which is centred on the self-organized criticality in Earth sciences, saw the light the very year Per Bak died prematurely. As known, Per Bak, Chao Tang and Kurt Wiesenfeld developed the concept of "self-organized criticality" (SOC) while studying the theoretical behaviour of sand piles, in 1987. After this paper appeared, and Bak's book "How the Nature works" of 1996, SOC was used as a new way of looking at complex systems observed in Nature, linking them to simple physical laws. According to this theory, large interactive systems will self-organize into a critical state governed by a law of power. Once in this state, small perturbations bring chain reactions, which can affect any number of elements within the system. SOC, the first general theory of complex systems with a firm mathematical basis has, since then, been applied to many other natural systems, including the size of earthquakes, the spreading of forest fires, the fluctuations of stock-market prices, and X-rays emitted by solar flares.

In this book Hergarten deepens the importance of SOC in Earth systems. The scale invariance property was known in Earth sciences well before Mandelbrot introduced fractal concepts in 1977 and 1982. Ruskin in 1860, described what a common problem in Earth sciences is very well: i.e. the need, when showing an image of a geological feature, to always include an object indicating the scale, to specify if the image is showing a feature on a regional or on a microscopic scale. Following Mandelbrot's work, fractal concepts were widely used to describe, among others, earthquake behaviour and their time and space distribution, fracturing mechanism, landslides and volcanic eruptions, fault distribution, and their pattern and shape, gold-mine distribution, and porosity (by Turcotte in 1992). Being scale-invariance, fractals and fractal dimension the basis of SOC, a book on the occurrence of SOC in Earth sciences is the logical continuation of these studies.

Part of the book derives from lectures and courses held by the author at the Universities of Bonn and Freiburg, in Germany. The reader benefits from this: the theory is exposed in a clear and comprehensive way, so as allow the reader to quickly familiarize with these concepts. Every chapter begins with an introduction that binds it to the previous one, and introduces the topic of the chapter. An appendix on ordinary differential equations completes the treatise. The references are complete, and give a precious hint on various works on fractals and self-organized criticality state-of-the-art in Earth sciences.

The first chapters give overviews of fractals, and deterministic chaos, the ingredients of SOC. Even if they are restricted to the most essential concepts to reduce the length of the book, these topics are very clearly treated. The reader is slowly led from the very simple concepts, of fractals and fractal dimension in space, to the more complex concepts of self-affine time series and to deterministic chaos. The fifth chapter introduces the basic concepts about SOC. The sixth chapter deepens the concepts of SOC, of tuning and universality through the example of the forest fire model, while the rest of the book focuses on examples from Earth sciences, namely earthquakes and stick-slip motion, landslides and drainage networks. The last two chapters present the lastest perspectives on the theory.

Following Hergarten's reasoning, we discover that SOC may be viewed more as a phenomenon, than a theory. But, as a phenomenon itself or as a theory, it unifies processes that appear very different to the classical approach, giving a common ground to multi-disciplinary research, that is the only way of really making progress in the understanding of Nature and of its manifestations.

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K. Stuwe
GEODYNAMICS OF THE LITHOSPHERE, AN INTRODUCTION
Springer Verlag, Berlin Heidelberg
2002, 449 pp., hard cover
ISBN 3-540-41726-5
69.95 €, 49.00 £, 116.50 sFr, 69.95 $

Kurt Stuwe's background in the of field geology, with a PhD in metamorphic petrography, is quite evident from his book "Geodynamics of the lithosphere". His capability of presenting and discussing the most significant aspects of quantitative geodynamics, is always supported by his sensitivity towards geological processes and scale.

This book is an introduction to the quantitative approach to a wide range of geological processes related to crustal reology and deformations. The aim is to introduce field-based geologists to the quantitative treatment of their field data.

It starts with a review of the same basic concepts, like map projections, structure of the Earth and plate tectonics, and continues with the presentation and discussion of the most important aspects related to quantitative geodynamics. All the most prominent processes that