PREFACE.

This is a book about short-term earthquake prediction, written for seismologists, geologists, and geophysicists, who are interested in the specific topic. Its aim is to introduce deterministic ideas, based on Physics, towards the solution of this problem, while, at the same time, the theory of Physics is applied into practice. The purpose of this book is, to show that the problem of short-term earthquake prediction, despite the fact that it is considered as unsolvable by the majority of seismologists, it can be solved, for the case of strong earthquakes, in terms of deterministic well-known Physics laws, and not only to add a new monograph, to the already existing, large number of books which refer to earthquake prediction.

The majority of the existing bibliography, which is related to the topic of earthquake prediction, is more or less distinguished in two main categories. The first one, which is the largest, refers to reviewing to date statistical methodologies in all aspects, already applied to, and, mainly, aiming to determine the time of occurrence (medium-term, long-term time prediction and to a shorter extent the magnitude) of a future strong earthquake, while the second one refers to various, published proceedings and concerns the papers, presented, in different workshops, congresses, international meetings etc which are dedicated to the topic of earthquake prediction.

Moreover, in terms of time prediction, the majority of the bibliography refers to medium-term or long-term prediction, since, generally, statistics are applied to study long periods of reoccurrence of seismic events which are present in earthquake catalogs and therefore, it is impossible to obtain results which could be referred as short-term prediction. On the other hand, it is very difficult, in mathematics and physics, to predict the behavior of a nonlinear physical system, far in the future, while, it is quite reliable to utilize it at the vicinity-time of the final event, which is studied, namely, the occurrence of the future, strong earthquake.

In contrast to these two bibliographic categories this book presents an integrated solution for the short-term earthquake prediction, which determines, in physical and mathematical sense, the three parameters (location, timing and magnitude), which are required in order to define a strong earthquake, and hence to utilize a successful prediction. The latter is achieved by the use of well-known physical mechanisms, different adopted, physical models, which are interrelated, for the formulation of the mathematical / physical solution, regarding each prognostic parameter.

This book has been written for Earth scientists (seismologists, geologists, geophysicists), who are interested in or already involved into the topic of "earthquake prediction". Since the mathematical background of the readers varies, having this in mind, the mathematical treatment, at a certain extent, has been omitted, although, indispensable formulae are included.

Actually, the collection and study of the material, which is included in this book, had started since 1981, when the **VAN** research group, initially, announced the **VAN** methodology for the prediction of the earthquakes. The large debate, triggered, between the seismologists and the **VAN** team, attracted my interest to study this problem, but from the Applied, Geophysical point of view. The result of this study, after almost 25 years of analysis of the data, occasionally available, and more recently of the obtained data, from an installed, experimental, monitoring network, indicated that the short-term earthquake prediction is an achievable target, provided that, the right physical models and mechanisms would be taken into account, to determine the required earthquake predictive parameters, for a future, strong earthquake.

In the course of the presentation of the material of this book, is made a short introduction about seismology, earthquakes, earthquake prediction and its evolution in time, types of prediction, predictability of earthquakes and earthquake precursors.

The location of strong earthquakes, lithospheric fracturing, depth distribution of earthquakes and some tectonic topics related to earthquake generation in the Greek territory, are dealt with, in an introductory, new way, since, these are new ideas, which are used in the analysis of the problem of short-term earthquake prediction.

The different electrical signals generation mechanisms are presented, since the various generated, earthquake precursory, electrical signals are the basic element of the methodology to be presented.

In the following sections, the earthquake prognostic parameters – time, location, and magnitude - are determined separately. Firstly, is discussed the theoretical background, which is followed by examples of the application of the theory in to practice, from data collected in the Greek seismogenic area. The integrated methodology is applied on specific strong earthquakes, which occurred in Greece, during the period 2000 – 2006.

In a separate section, is presented, the utilization of the methodology in field conditions and, specifically, the technical description of the monitoring network which is required for the implementation of the methodology. The data processing flow-chart and data processing examples are presented, from actual recordings made in the Greek territory. The presently active, monitoring network, which is used in Greece, for the implementation of the methodology and its future expansion final scheme, is shown and discussed.

It must be pointed out that this book, in the majority of its material presented, focuses to the physical problem itself rather than into detailed, mathematical analysis. Therefore, the required mathematical analysis, regarding each discussed topic, is kept at minimum. However, extensive references are presented, for those interested in mathematical details. This facilitates the understanding of the new ideas and the overall philosophy which is followed and concerns the proposed, integrated solution.

Moreover, the theoretical analysis, which is presented, is followed by real examples, along with a large number (573) of figures, which are explanatory to the theory and to its application in practice, as well.

Some times, introductory material and earlier research work is repeated, at different sections of this book. This serves the purpose to provide the reader, each time, with an integrated view of the background of the topic dealt with, in each section.

Finally, an overall summary is presented, which discuses the entire methodology and speculates its drawbacks and merits.

All along the text presentation, is given a large number of references to more detailed papers and bibliography, related, to each topic discussed.

A real-time application of the presented methodology and its present status application, in Greece, can be viewed in our web site: **www.earthquakeprediction.gr**

The data, which have been collected by the installed, monitoring network in Greece, during its operation (almost 4 years), are included in an attached CD, along with all the material, needed, for a third party evaluation of the methodology.

22nd September, 2007   Constantine Thanassoulas

Dedicated to:

- All those, who lost their lives or have suffered a lot, by disastrous earthquakes

- my wife Aleka

and

- to the memory of my parents Areti and Panayiotis.

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