# TEACHING EARTH SCIENCES. A METHOD BASED ON EXERCISES

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## Abstract

For many years I have taught courses on general geophysics and seismology at undergraduate and graduate level. In these courses, main effort was paid on transmitting the students, with different degree of success, the basic concepts and their professional application. Since earth sciences are semi-empiric disciplines in this task the major obstacle found is the lack of an appropriate method for teaching simultaneously the two aspects, theory and practice. Besides, the lack of appropriate resource material to carry out illustrative examples that can be handled with commonly-found classroom computer programs is an additional obstacle.

The wide variety of students scholastic background constitute also a obstacle in the preparation of a course that satisfies both, the ones who expect to become earth sciences professionals from those who want only to use earth sciences as a working tool. Thus, preparing a course in such conditions is not easy task. It requires to be pleasant with a simple language but without loosing scientific rigor, dotted with anecdotes of personages and events that motivate the students to become part of the earth science world. This is the main the objective of the present contribution. To prepare, using recent advances in instrumentation especially computers, a method of teaching earth sciences on the assumption that one learn by doing and through real experience.

Keywords: Teaching, Earth Sciences.

## INTRODUCTION

Several excellent seismology text books has been published recently [1]. In most textbooks there is a clear separation, inconvenient for teaching purposes, between the seismological theory and its practical usage. This separation is not accidental, but is the natural result of the seismology historical development. The notable mathematicians and physicists that developed the seismological theoretical bases actually worked independently from observational seismologists. Thus, for example, the basic theory of the generation and transmission of a disturbance in a homogeneous and perfectly elastic medium used by Cauchy and Poisson in 1828 to prove the existence of the two types of waves, longitudinal and transversal, it was until 1900, that is 72 years later after a formulation of the theory, when Richard D. Oldham identified without doubt the seismic signals in the seismograms.

## IMPORTANCE OF EARTH SCIENCES IN DEVELOPING COUNTRIES

Mexico is located along the circumpacific seismic and volcanic belt, the most active region in the world. Consequently, the probability of a major earthquake and volcanic eruption occurrence is very high. In the last one hundred years there have been at least ninety destructive earthquakes in Mexico. Thus, the study of this phenomenon should be considered a national priority. Ironically, the interest of the government and society it is minimal as compared to the magnitude of the phenomenon. The young students at the universities also show this lack of interest, basically we believe, because of a poor diffusion of the importance of science and inadequate teaching methods. Based on these considerations in the present project we propose the elaboration of a dynamic and formative textbook that help to capture the imagination of the new generation of earth science students.

## TEACHING METHOD STRATEGY

To prepare a technical textbook for all public is not an easy matter, it requires to pleasant, written in an easy language without loosing scientific rigor. Sprinkled with anecdotes of the personages and events that constructed the particular discipline to make the reader part of this world. Thus, our project has a unique objective, to prepare a modern textbook (see Fig. 1) easy to understand for earth science

professionals and to the users of earth science information, using seismic digital information and computational resources available at any classroom or in the *web*. To reach this task the theory is presented in a simple but rigorous manner illustrated with a great number of real seismograms from regional and teleseismic events as convenient. Additional exercises are proposed to gain experience in handling seismic information. The accuracy of the parameters calculations is a factor of major importance in the discussion of the exercises. A CD-ROM accompanying the textbook contains a series of digital seismograms and other pertinent information and is prepared in such a way that only a minimum knowledge of computers is requires to be used. Finally, since the theoretical equations used in the calculations are complicated and difficult to visualize, several procedures and animations are elaborated using the MATLAB package to explore the extent of the equations.

## CONTRIBUTIONS TO THE PROGRESS OF TEACHING

The integrated treatment of the physical concepts used in seismology, its mathematical representation and its immediate application to real problems is probably the main differences with respect the traditional textbooks, in which theory and practice are approached separately. The integrated of theory and practice as proposed in this teaching project it is more than a textbook, its represents a method of teaching earth sciences according to modern times. This way of teaching not only constitutes a modernization in teaching earth sciences, but also we expect to capture the imagination of a great number of young students.

We expect that this teaching project provide the tools and the knowledge to the new science professionals to be capable of interpret and synthesize a wide kind of geophysical information to understand the natural phenomena.

## REFERENCES

[1] Jose Pujol. Elastic Wave Propagation and Generation in Seismology. CAMBRIDGE. University Press. 2003.