

Short notes from a journey through earthquakes and historical records

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Abstract

With the expression «historical seismology» it is meant today a branch of earthquake investigation which contributes answering one of the main seismological commitments: to expand the knowledge of earthquakes as far back in time as possible. To fulfil this commitment this branch of seismology makes use of historical records and methods; in recent times historians started taking care of this problem, in most cases collaborating with seismologists. The historical earthquake investigation, to reconstruct the seismic history of an area, can be seen as a sort of journey through time, space, repositories, sources and earthquake records, which can be performed at different speeds depending on budget, time and users' request. This paper presents some impressions from one of these journeys, performed by a seismologist. The main checkpoints of the journey are analysed with respect to the impact on both historians and seismologists: difficulties encountered by historians to find out a strategy for answering seismological questions are presented; on the other hand it is analysed how attempts of applying current seismological methods to historical records encounter some difficulties, due to the nature of data and the lack of care by investigators.

Key words *earthquakes – historical records*

1. Introduction

The following notes, reporting some impressions of a seismologist from a journey at the border between the history and seismology disciplines, are mostly devoted to historians and are not meant as a treatise. Therefore references, that would need a very long list, are kept to a minimum; a few of them can be found in Guidoboni and Stucchi (1993).

2. Historical seismology

The investigation of historical earthquake records dates as far back as centuries; the main output of such investigation was generally a collection of earthquake records, usually presented in a chronological sequence (earthquake compilation). The historical record is usually considered poor, with respect to the instrumen-

tal one; it is a common assumption that seismology became a science along with the development of recording instruments only.

However, instruments are relatively «young» with respect to geological processes and earthquake history; therefore, to study the seismicity and to assess seismic hazard seismologists need to make use of earthquake records of varied types, such as written accounts, archaeological and geological evidences, etc. Though all records are useful, each type of them is the leading one for a certain time-interval; written accounts are the main source of information for at least the last millennium (fig. 1).

For these reasons, in recent times many seismologists, most of them almost unaware of historical methods, started dealing with a number of earthquake compilations and using them for compiling a number of parametric catalogues, which still represent the main basis for seismicity and seismic hazard assessment. At the same time they also wished to improve the available knowledge and started retrieving and

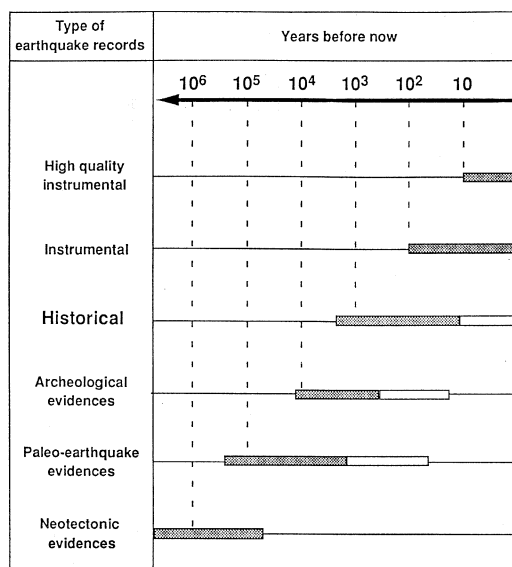


Fig. 1. Time intervals covered by different types of earthquake records (from Gürpınar, 1989, revised). Time-windows for which each type represents the main source of information are evidenced.

interpreting historical records: this task was often performed without method and care, leading to many inconsistent results. At that stage many investigators made use of terms such as «historical earthquakes» and «historical seismicity» which, mixing up the investigation method (historical) with the investigation subject (earthquake textual accounts), for instance lead to the wrong, though still widespread equation:

«historical earthquakes = earthquakes before 1900»

In the 70's a few investigators started using rigorous historical methods and sought the collaboration of professional historians. Today it is increasingly agreed that earthquake investigation requires to follow scientific procedures and that, on the other side, handling historical records requires to use historical methods. The term «historical seismology» – coined as early as 1988 by Vogt when addressing some basic concepts about historical records to seismologists (Vogt, 1988) – appears today as the most

appropriate one for defining the branch of earthquake investigation which fulfils the two requirements. As a matter of fact, «seismology» means «earthquake investigation», while «historical» defines type of recorder and related procedures. Therefore, the term «historical seismology» incorporates two concepts:

- it means a branch of seismology, that is earthquake investigation making use of scientific procedures;

- it points out the use of historical methods, that are rules and procedures typical of history, and different from «classical» seismological methods.

As a branch of seismology, historical seismology has a well defined commitment: «to expand the knowledge of seismicity as far back in time as possible».

This commitment strictly addresses and constrains historical seismology. First, to meet it historical records are to be selected among those allowing to answer seismological questions, such as «when?», «where?», «what size?». Next, historical records need to be turned into numbers; this process, infrequent in science, is still performed in a rough way, far from being transparent.

The two constraints have some importance. On the one side, historians and «data producer» seismologists are fully aware of the qualitative nature of historical records and wish to avoid spoiling them or forcing them to say what they cannot say. On the other side, engineers and «data user» seismologists steadily require quantitative data, no matter whether the black-box which produces the numbers, apparently allowing the transformation of «qualitative» into «quantitative», is poorly calibrated and even poorly explored. It is worth recalling that such numbers, though written in the current way, have special roots which should not be forgotten afterwards.

3. The journey

The journey reported here can be seen as a journey through space and time that historians and seismologists perform, sometimes together, sometimes alone, to retrieve and inter-

pret earthquake records and to compile them in seismological terms. Usually, the final goal of this journey is the compilation of the seismic history of an area, which often takes the shape and the name of «earthquake catalogue».

Depending on the region and time-window to be investigated, such a journey may be devoted to a few earthquakes or to a few thousands. In order to make non-seismologists aware of the size of the journey, the seismic history of Italy and part of neighbouring countries includes, in the last 1200 years, more than 3000 damaging earthquakes: this figure can easily duplicate or even triplicate by taking into account the damaging aftershocks. Obviously, the time-distribution of these events is not regular, due either to the uneven seismicity pattern or to the uneven distribution of historical records.

As for all journeys, travellers must be prepared to solve problems of language, schedule, budget, etc., and to cross some checkpoints; this requires experience, adaptation, flexibility, and so on. For instance, time interval, size and seismicity rate of the area to be investigated make some difference, because time and funds of the travellers are often limited: obviously, a tourist who has enough time and money to devote one full month to Rome and, perhaps, Florence, will proceed in a different way from one whose commitment is to prepare, in the same amount of time, a guide of the Aegean Islands.

Therefore, investigators must adapt strategies and methods to circumstances: in many cases they will be forced to follow shortcuts or, at least, to adopt preliminary approaches which allow to get to the goal quickly, but not to perform exhaustive investigation. The impact of these constraints on travellers/investigators has not been well understood so far; however, it is a matter of fact that candidate travellers of this kind are today fewer and fewer.

4. Historians' problems

Apparently, the impact of this kind of journey on historians is heavy, perhaps heavier than on seismologists.

First of all, earthquakes are special events, even for natural phenomena. Actually, single

earthquakes develop within seconds, a few minutes at most; after this time, other earthquakes take place within the same day, the same week or longer. The effects of earthquake sequences may last for months or years, and historians may be attracted by global analysis, also because historical records often report global effects. On the other hand, seismologists would like to have reliable parameters (when? where? how large?) of single earthquakes, while historians are seldom accustomed to deal with such a narrow time scale. Moreover, in the aftermath of a large earthquake witnesses become oversensitive, the main recording instruments – the buildings – are out of order or just «saturated», as their response is no longer elastic; therefore, records are difficult to interpret.

Furthermore, to establish «where and how large» seismologists need information from as many localities as possible. This means that even poor records, if reporting from many localities, could be more useful than very detailed records concerning one locality only.

All these considerations mean that historians might find themselves dealing with types of sources and information which usually do not fit in their common experience: for instance, a single earthquake report, a few lines long, can be as valuable as a full archive file for historical seismology.

Finally, the journey requires investigation covering large time intervals, large areas and many earthquakes in a short period. Each earthquake consists of at least a piece of information coming from one locality: depending on the time-period and the size of the earthquake considered, a few or even many records are available. Therefore, the journey may encompass hundred to thousand years, develop through hundreds of repositories and deal with tens of thousand sources and records; often, this journey must be completed in a relatively short time, and sometimes such a perspective causes strong reactions from the historians.

More generally, it might require the adoption of simplified or *ad-hoc* approaches. For instance, most current parametric catalogues rely upon the so-called seismological compilations; sometimes it is opportune to retrieve and

evaluate their roots, and this would mean the reappraisal, with criticism, of the heritage represented by them and by their sources, the value of which is in some cases considerable. Obviously, few historians are happy to spend part of their time following the tracks of previous investigators, retrieving and using their sources again, checking interpretations, detecting «mistakes», and so on, although the results of such a work are often of great value for the assessment of seismicity and seismic hazard.

5. Seismologists' problems

The main checkpoints for seismologists are connected with the use of historical records for the assessment of earthquake parameters. To perform this task, textual accounts are first interpreted in terms of macroseismic intensities; then, from the intensity distribution, earthquake parameters are assessed.

The first step is nothing less and nothing more than a problem of language, where numbers are today «English», that is the more widespread – and, therefore, of higher level – language, while textual accounts are the other languages. This step is performed by means of macroseismic scales; problems related to this point are well known and are dealt with by

many papers (a few of them also included in this issue). However, it is worth recalling that historical, written records often provide a wealth of information, which is usually spoiled or just thrown away when they are transformed into intensities.

The second step, earthquake parameters determination (when, where, how large), is the seismological «must» which is responsible for many shortcomings and pitfalls performed by the compilers themselves. To understand better the situation one has to go back to the model to which historical seismology, though not explicitly, inspires itself, that is, the elaboration of instrumental data. Methods for answering «when», «where» and «how large» are well established in this case: they make use of arrival time differences at many recording stations and of calibrated procedures; modern seismology locate and quantifies earthquake parameters as a routine operation. Things are not so easy for earthquakes before the 60's, when timing precision was poor, instrumental records still came from poorly calibrated instruments; moreover, sometimes they are now lost or unusable. Today, to study such earthquake records may also require some «historical» investigation to find out records, retrieve calibration curves, check timings, etc.

Such difficulties, however, are not compara-

Table I. Comparison between the main steps of instrumental and historical earthquake records processing.

	Instrumental records	Historical records
<i>To be found where?</i>	Agencies Institutes Observatories	Libraries Archives
<i>Timing and calibration of the record</i>	Routine	Requires investigation of: – source – author – wording – intensity assessment
<i>Location of the origin of the record</i>	Known	May require careful interpretation
<i>Determination of focal parameters and their reliability</i>	Standard procedures	Non-standard, often personal procedures
<i>One or two primary data only</i>	Earthquake discarded	Parameters determined

ble with those typical of historical seismology. Table I, comparing main steps and problems, gives an idea of the differences. The main problem is the fact that, surprisingly enough, there are no standard rules to assess earthquake parameters from historical/macroseismic data; though a few attempts are being developed in recent years, most investigators still make use of personal, unreported procedures.

Moreover, in many cases the information carried by historical records is not suitable for assessing focal parameters at all; sometimes it is very poor, sometimes data are not coherent in time and space, so that one is not sure whether it belongs to the same earthquake, and so on. Nevertheless, catalogues' compilers (the travellers) are forced by users to assess earthquake parameters: therefore, they often were – and are still – in such an awkward situation to be forced to choose between assessing parameters, whatever the cost, or losing the corresponding information forever; and this obviously led to shortcomings.

It can be observed, for instance, that no seismologist would include an earthquake in a parametric catalogue, even a strong or a moderate one, for which only one instrumental observation is available, for the simple reason that, in such a case, routines would not work. On the contrary, do historians – and seismologists – guess how many heavy damaging earthquakes ($I_0 \geq 7-8$ MCS), supported by one observation only, are listed in current parametric catalogues before 1900? Considering the ones for Italy by Postpischl (1985) and Stucchi and Zerga (1994), the answer is about 40% and 20% respectively! Obviously a single observation can be very important (for a medieval earthquake it often means all what can be expected); however, it does not necessarily represent «epicentral» data. Apparently, in such cases seismologists turn a blind eye to their own rules.

6. Conclusions: a common journey?

Problems of collaboration between historians and seismologists are often reported as

problems between «qualitative» and «quantitative». Is there any possibility to match the two contributions on a scientific but also even basis, not only relying on the hope to be later rewarded with some just «quantitative-looking» data? The minimum requirements seem to be:

- to define common goals;
- to find out a positive alternative to the traditional hierarchy according to which only «quantitative» is good;
- to establish rigorous, transparent procedures, acceptable from the standpoint of both historians and seismologists;
- to avoid forced parameterisation of historical records not suitable for such a purpose;
- to learn using historical records according to their full potential.

A common journey, during which historians and seismologists learn methods and procedures from one another and develop common procedures is possible: but the way is still long and it requires flexibility from both parts. Historians must get aware that, surprisingly or not, seismologists often and easily forget their scientific rigour when dealing with historical records, throwing the blame on the nature of the data. For the seismologists the way is even longer; it passes through the users' capacity of adapting models and computer routines to the nature of historical records.

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