

SIXTH FRAMEWORK PROGRAMME

Structuring the European Research Area Specific Programme

RESEARCH INFRASTRUCTURES ACTION



Contract for an

INTEGRATING ACTIVITY

Implemented as

INTEGRATED INFRASTRUCTURE INITIATIVE (I3)

Annex I - “Description of Work”

Project acronym: NERIES

Project full title: Network of Research Infrastructures for European Seismology

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<b>Activity number</b>	<b>NA4</b>		<b>Start month</b>	1	<b>End month</b>	48			
<b>Activity Title</b>	<b>Distributed Archive of Historical Earthquake Data</b>								
<b>Participant number</b>	11	14	20	3	16				
<b>Participant short name</b>	INGV	BGS	ICC	ETHZ	ITSAK				<b>Total</b>
<b>Total person-months</b>	57	14	37	11	17				<b>136</b>

### **Objectives and expected impact**

The return period of the largest and most destructive earthquakes is measured in millennia. For estimating seismic hazard, seismologists thus cannot rely on the instrumental record starting in the early 20th century, but critically depend on the integration of historical earthquake information. Historical earthquake data are written records of the seismic effects of the past millennium, as supplied by historical sources. They are usually interpreted in terms of seismological parameters, the most common one being the macroseismic intensity.

Databases of intensities and derived seismic parameters are an essential source of information for a wide community of users, particularly earth scientists, engineers, planners and insurers, for assessing long-term seismicity and seismic hazard.

Intensity data in Europe are still collected and archived in isolation by many of the seismological observatories, with varying criteria and degrees of commitment. Only few countries (Italy, France, and Switzerland) have a consistent, available set of historical earthquake data, interpreted in terms of macroseismic intensity data points (IDP). In other areas, scattered data are available on paper, though the coordinates of the data points are not easily obtainable and the place-names are missing in many cases. While a uniform intensity scale has recently been established for the Euro-Med region (EMS98) and is now widely used, existing databases for historical earthquakes have been compiled using a variety of intensity scales. Homogenisation and consistent documentation of many studies and data across Europe is missing.

This is in stark contrast with the corresponding situation in the USA, where the centralised Earthquake Intensity Database provides more than 150,000 IDP data for over 23,000 damaging events after 1638, with the whole data set freely available on the Internet. Europe has a much longer history than the US, and needs to efficiently network historical data archives in order to be able to provide a pan-European, homogeneous intensity database to provide Euro-Med users with access to this kind of data, available at a variety of seismological infrastructures throughout Europe.

Catalogues of historical earthquakes extending back up 1,000 years in the past are available in many countries of the Euro-Med region, with various degrees of completeness and accuracy. Several attempts have been made to compile a unified catalogue for the whole region and period; the quality of the resulting catalogues has been hindered by the non-homogeneous quality of the databases and input intensity data.

NA4 aims at improving this situation and will establish the required tools leading to the compilation of a comprehensive, digital macroseismic intensity database for the largest European earthquakes (with magnitude  $\geq 5.8$  at least) and a validated and homogeneous European parametric earthquake catalogue for  $M \geq 5$ , to serve as an authoritative reference for users involved in the assessment of seismic hazard and risk. The main focus will be devoted to the time-window before 1900.

This resource, integrated into the new seismological portal as a community resource (NA7, NA9), complements the ongoing efforts in real-time seismology (NA2, NA3).

## **Description of work**

### **Task 1 - *Inventorying the existing data***

The first step will consist of a careful survey of the existing data (both in digital form and paper) and their characteristics. A preliminary, comprehensive earthquake data inventory will serve as a reference, to which the characteristics of the retrieved datasets will be attached. In the case of multiple studies of the same event all the datasets will be inventoried as they are.

A first version of the inventory - up to 1600 - will be made available after month 12; it will be implemented on a rolling programme, with annual release, and made available on the web with two kinds of access: i) partners of the project and contributors, who will be able to upload data according to a well established protocol; ii) users, who will have access to well-established data only.

### **Task 2 - *Collecting and qualifying the data***

Earthquake studies without IDP will be digitised in PDF format and made available through the portal and/or CDs. Earthquake studies with IDP will be analysed, in order to: i) evaluate the reliability of the data, ii) assess a standard format for (re)compiling IDP according to homogeneous criteria, in such a way that each entry will contain: a) time of earthquake occurrence; b) place-name, its identification and geographical co-ordinates as from the directory; c) assigned intensity value; d) a quality value representing the reliability of this datum for general use.

A first set of data, corresponding to the same time window as for Task 1 - will be made available after month 24. The data set will be then implemented according to Task 1 progress.

### **Task 3 - *Implementing database mining tools and homogenization of the macroseismic intensity database***

Common specifications and access procedures for existing European databases will be designed in such a way as to provide: (a) access by earthquake, to extract the intensity data points, and (b) access by locality, in order to provide seismic histories at the sites. The software to retrieve and visualise data will be structured in such a way as to be customisable and tailored to specific and different end-user requirements, and installed at the various databases. The layout of the web access will be designed in order to provide multiple views highlighting relationships between the data, for example providing, side by side, lists of data and their cartographic representations: IDP and maps, in the case of query by earthquake, or site intensities and graphical seismic history, in the case of query by locality. Data from large earthquakes will be progressively homogenized and made available to users, starting with the data from the datasets already structured.

A first release of the database will be made available after month 24 and it will be updated on a yearly base.

### **Task 4 - *Merging and homogenization of the European parametric earthquake catalogue***

This task will continue throughout the project in a rolling programme up to month 48. Specific areas and time windows will be prioritised according to the data availability. Starting from existing European compilations, the parameters of the earthquakes will be reassessed according to homogeneous procedures on the basis of the intensity data sets gathered in Task 3 or on the basis of the material made available at Task 2. A special section of the catalogue will be dedicated to the earthquakes, which, listed in national, or regional catalogues, have been demonstrated to be false by accurate historical investigation.

The first release of the parametric catalogue will be delivered after month 30.

### Milestones

M1	- Reference earthquake inventory established and made available; guidelines for compiling the intensity datasets and a demo version of the intensity database online;
M2	- First release of: i) inventory and collection of earthquake studies; ii) intensity database for large European earthquakes; iii) parametric earthquake catalogue. The interaction of the users starts;
M3	- Final release of i) inventory and CD collection of earthquake studies; ii) intensity database for large European earthquakes; iii) parametric earthquake catalogue;
M4	- Release of procedures and recommendations for permanent implementation of the archive in the NERIES portal.

### Deliverables

#	Deliverable title	Task	Month	Nature
D1	Reference catalogue and guidelines	1,3	12	File, report
D2	Inventory and collection of historical earthquake studies	2	24	Report, file/DB and CD/online
D3	Intensity database of large European earthquakes	3	24	Database
D4	European parametric earthquake catalogue for $M \geq 5$	4	30	Report, file (online)
D5	Final report, including recommendations and agreement of the host institution to continue the initiative	Coordinator	48	Report
D6	Integration in the European portal (to be done in NA7)	Coordinator	48	Online

## E. DETAILED IMPLEMENTATION PLAN AND PROJECT RESOURCES FOR THE FIRST 18 MONTHS

### 1. Detailed implementation plan of the Networking Activities for the first 18 months

2.

<b>Activity number</b>	<b>NA4</b>		<b>Start month</b>			1	<b>End month</b>		18
<b>Activity Title</b>	<b>Distributed Archive of Historical Earthquake Data</b>								
<b>Participant number</b>	11	14	20	3	16				
<b>Participant short name</b>	INGV	BGS	ICC	ETHZ	ITSAK				<b>Total</b>
<b>Total person-months</b>	10	3	8	5	11				<b>37</b>

### Objectives and expected impact

The main objectives of the first phase of the project will be:

- to retrieve, analyse and update the material already inventoried in the frame of previous national and international projects (namely the BEECD EU project);
- to compile the reference earthquake data inventory and to upgrade it; interacting with the seismological institutions which are not taking part in the project;
- to start collecting and making available the inventoried material, with main attention to the time-window 1000-1600;
- to discuss the procedures and the format according to which existing macroseismic intensity databases have being compiled; and to assess common procedures for the establishment of a common, macroseismic intensity database;
- to start the assessment of the criteria for the determination of the earthquake parameters according to which the European parametric earthquake catalogue will be compiled.

The accomplishment of these goals will provide a solid background for the continuation of the project and will send out a signal to the scientific community that the huge gap existing in one of the main input data for the assessment of seismic hazard in Europe, well known and stressed by most of the users, is on the way to be filled in.

### Description of work

The first 18 months will see the assessment of the procedures and tools for producing historical earthquake catalogues; a task which in the past has been hindered by the non-homogeneous quality of the databases and input intensity data.

The main time-window will be 1000 (and before) to 1600 (at least). The collection of national and regional earthquake catalogues will build on and upgrade the critical collection and merging already performed in the frame of a previous project. The earthquake inventory will identify individual earthquakes, sorting out duplications and fake events; the main studies related to individual events will be listed, retrieved, classified and made available in a digital form. Where needed and possible, some contradictions will be sorted out and a new reference study will be compiled.

The inventory will be first compiled and agreed between partners; then it will be put on a web site - with limited access - so that selected members of the scientific community will be able to comment and/or propose new information. Consulting a larger, European selection of expert users is essential for the success of this module, since the number of partners and the available resources are limited.

A demo version containing earthquake data from 1000 to 1300 will be made available after month 6.

Historical earthquake studies can be roughly divided into two categories: a) those consisting in a text which summarises the investigation performed, the sources used and the distribution of effects; b) those which also supply the distribution of effects in terms of intensity datapoints. Since there is no international reference standard, studies come in varied formats which stick more or less to the two main categories.

To make available to public the material of type a) requires retrieval, checking and scanning it. In some cases, problems of copyright or confidentiality need to be solved. It is expected that most, if not all, the material concerning events with magnitude approximatively greater than 5.5 (at least) in the aforementioned time-window will be made available at the end of month 18.

Material of type b) is in principle more useful for seismologists and end-users; on the other hand it is not often available and requires careful homogenisation of place-names, coordinates and macroseismic intensity scale. The project will build on the existing, public digital databases (IT, CH, FR). First, general problems among them and specific ones related to individual earthquakes listed in more than one database will be solved. Next, the database will be extended to digital data from other countries. Again, the success of the project will depend also on the collaboration of institutions not belonging to this project, whose collaboration will be sought in all possible ways.

A demo version of the European intensity database, including earthquakes from 1000 to 1600 with magnitude above 5.5, will be released at the end of month 18. The web interface will be designed in such a way that access will be possible (a) by earthquake, to extract the intensity data points, and (b) by locality, in order to provide seismic histories at any site.

The most popular tool used for seismic hazard assessment is still the parametric earthquake catalogue, that is, a list of earthquake parameters - such as time of occurrence, location, magnitude, depth, etc. - that can be computer-processed. While in the case of instrumentally recorded events whose parameters are determined from waveforms, in the case of historical events such parameters are determined from intensity datapoints or, mostly in the past, directly from the damage distribution, according to personal procedures. Each national or regional earthquake catalogue adopts individual procedures; this is why merging national catalogues into a comprehensive one is a dangerous and often misleading procedure.

This project will mostly determine parameters from intensity datapoints according to procedures which will be agreed in the first phase of the project. Obviously, this will be possible for large and well studied earthquakes only; for earthquakes without intensity datapoints an attempt will be made to compile them or, failing that, uniform simplified procedures will be adopted. For earthquakes with a sufficient number of intensity datapoints, also the azimuth and the dimension of the seismogenic source which caused the earthquake will be estimated and included.

A demo version of the European parametric earthquake catalogue, including earthquakes from 1000 to 1600 with magnitude above 5.5, will be released at the end of month 18.

