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ENGENHARIA SÍSMICA E SISMOLOGIA / EARTHQUAKE ENGINEERING AND SEISMOLOGY

Strong motion network IST Portugal

15 WCEE - Lisbon, September 24-28 2012

Carlos Sousa Oliveira
(Susana P. Vilanova)

ICIST - Instituto de Engenharia, Território e Construção do Instituto Superior Técnico

The IST Network

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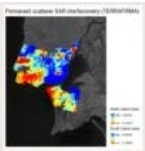

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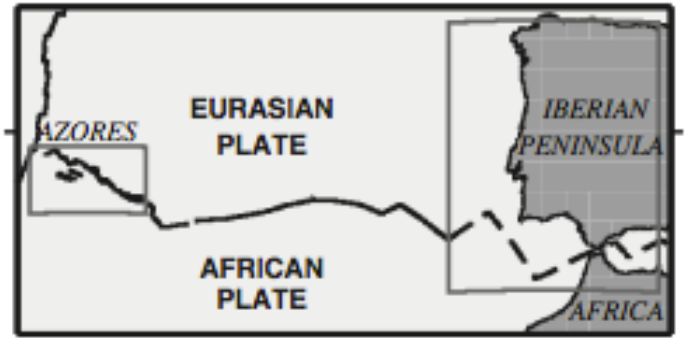
Portuguese accelerometer network 2008



The IST Network

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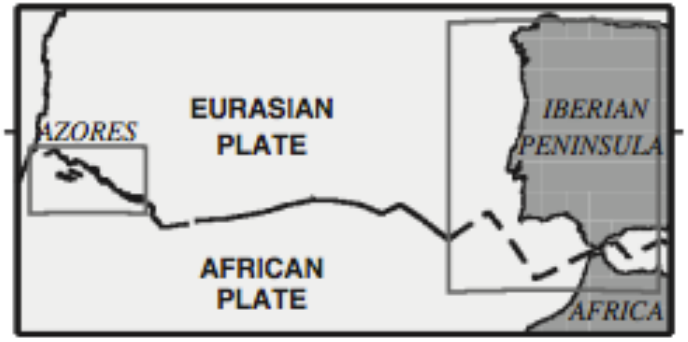
Portuguese accelerometer network 2008

Portuguese accelerometer network up to 2008

- 32 permanent stations
- 80% stations run by IST (12+13)
- 70% instruments installed at the ground floor of low-rise buildings (up to 3 floors)
- 73% stations located on stiff-soil/rock categories



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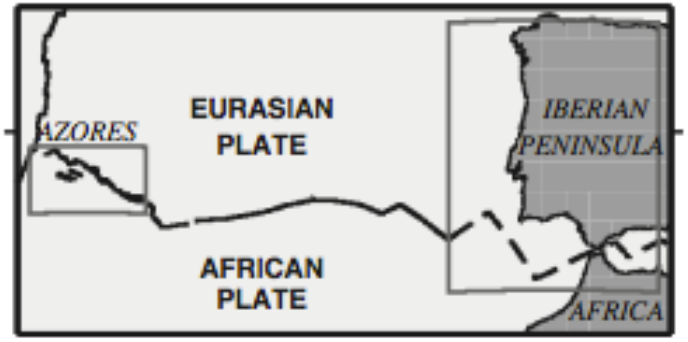
- 32 permanent stations
- 80% stations run by IST (12+13)
- 70% instruments installed at the ground floor of low-rise buildings (up to 3 floors)
- 73% stations located on stiff-soil/rock categories
- sensors: mostly GeoSIG SSA-320 force-balance tri-axial
- digitizers GRS12 (mostly), GSR16, GSR18
- Operated in triggered mode
- No GPS, no telemetry



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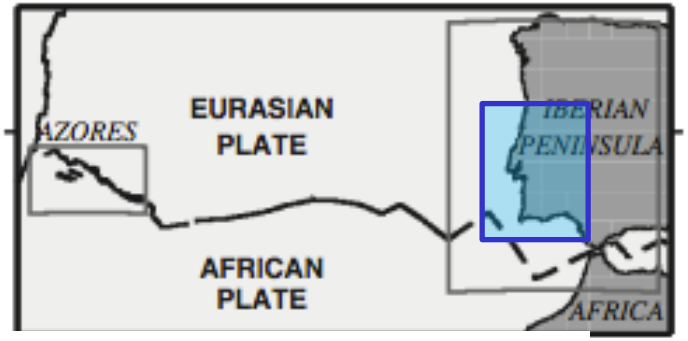

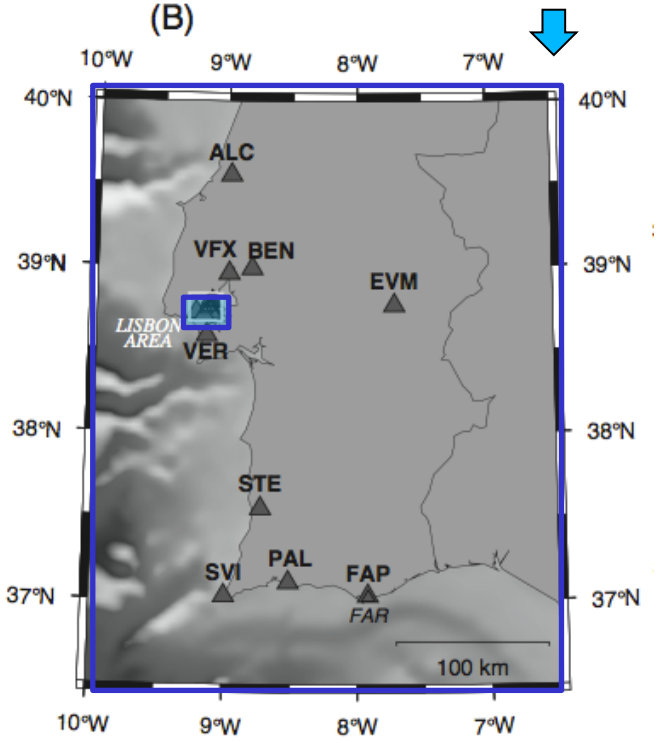

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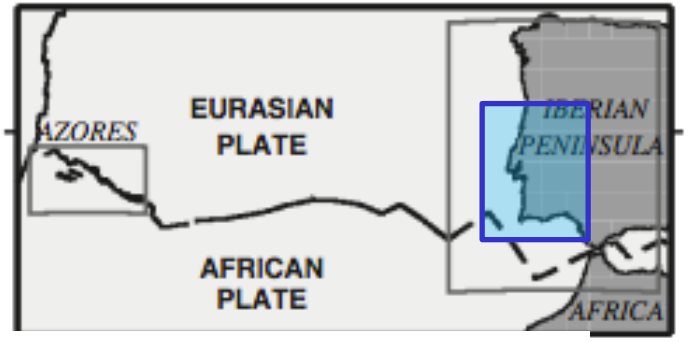

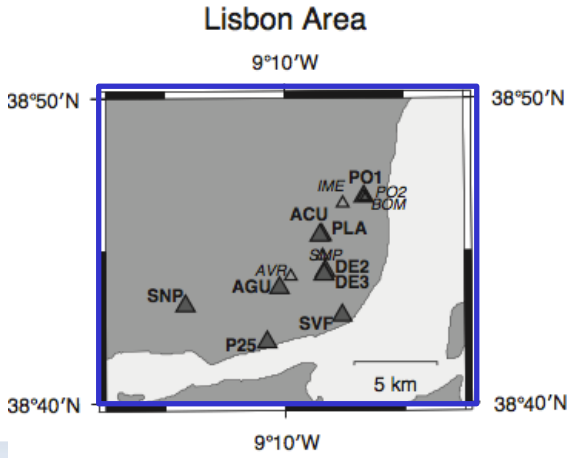

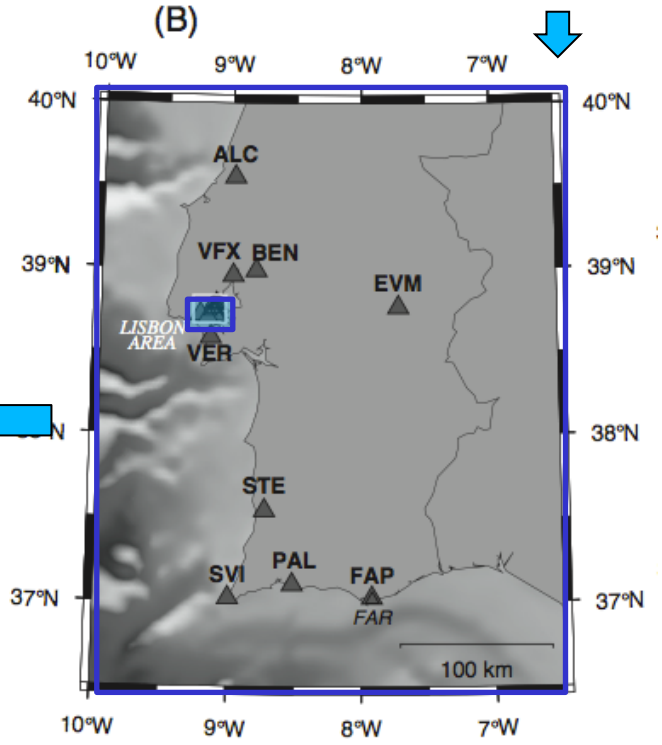

IST Network

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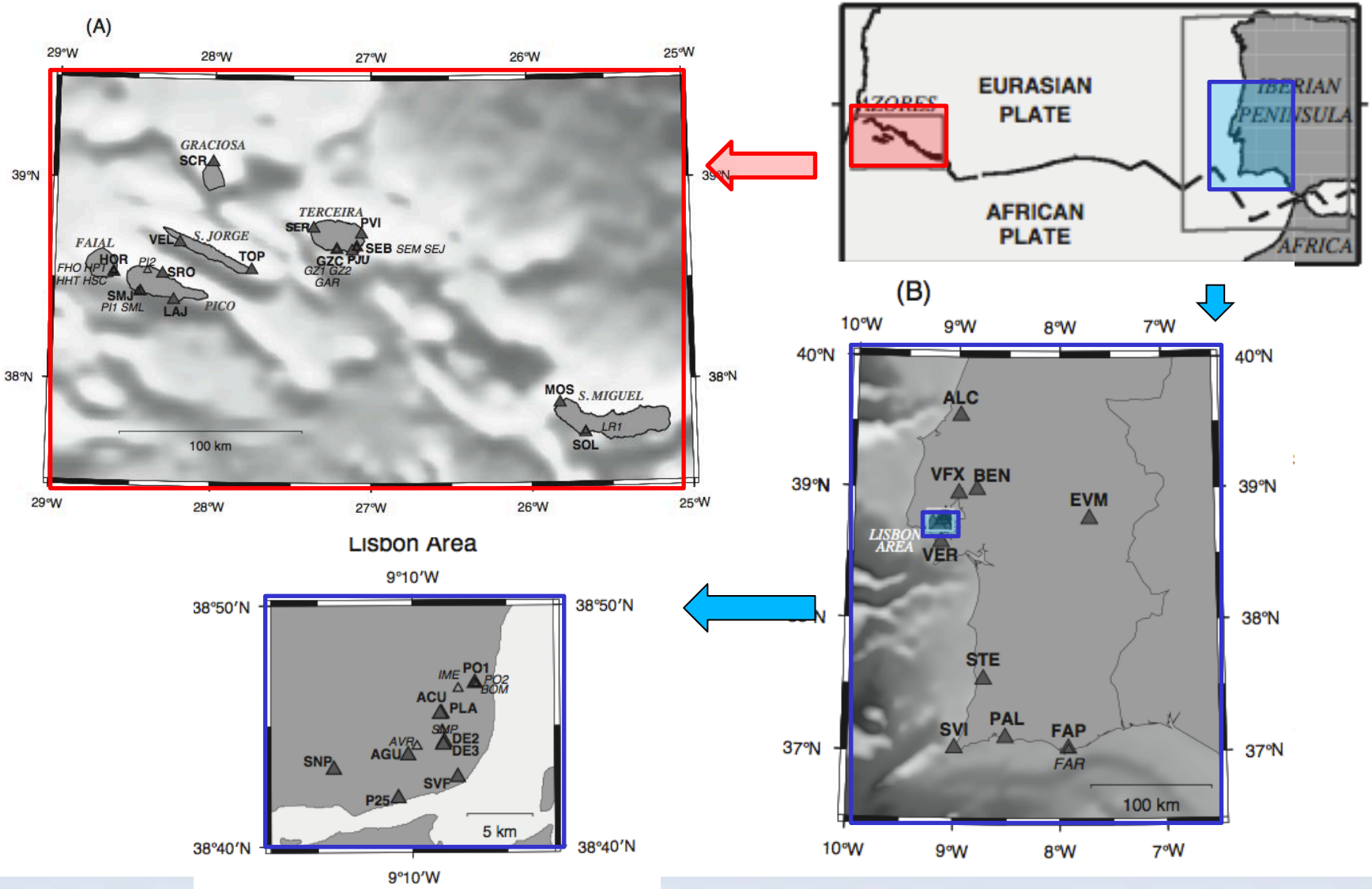

Efforts towards data dissemination

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ENGENHARIA SÍSMICA E SISMOLOGIA / EARTHQUAKE ENGINEERING AND SEISMOLOGY

Data dissemination efforts

NERIES-NA4

- Implementation of a database of national strong motion records and metadata (SQL)
- Distribution of CD-ROM

(downloadable file)

- Publication article in SRL

PAD-1.0 Portuguese Accelerometer Database, CD-ROM Edition

S. P. Vilanova, M. A. Ferreira, and C. S. Oliveira
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INTRODUCTION

Mainland Portugal, located in the vicinity of the Azores-Gibraltar plate boundary, is exposed to large magnitude (M 8.0–8.5) distant interplate earthquakes and moderate magnitude (M 7.0) local intraplate earthquakes. Such events, although infrequent, are relevant in terms of seismic hazard assessment and risk management, in particular in the Lisbon metropolitan area and the Algarve region (Vilanova and Fonseca 2007). The Azores archipelago, located at the North America, Eurasia, and Africa triple junction, is the source location of frequent low-magnitude events and seismic swarms and occasional moderate (M 7.0) magnitude earthquakes. Figure 2(C) shows the general tectonic setting of the above-cited regions.

Under the framework of the European Commission Project NERIES (Network of Research Infrastructures for European Seismology), the Portuguese accelerometer database PAD-1.0 was organized in a MySQL server and compiled in a CD-ROM edition. For each waveform, PAD-1.0 includes relevant information on the earthquake parameters, recording stations, and recording instruments, and a simple query interface allows users to select data that fulfills specific requirements. The search interface and the data request follow very closely the format implemented at the Internet site for the European Strong-motion Database (http://www.isesd.cv.ic.ac.uk/; Ambraseys *et al.* 2002).

The publication of ground-motion data is generally recognized as an important step toward understanding ground-motion properties worldwide (*e.g.*, Theodulidis *et al.* 2004). This work represents a first effort toward the organization and dissemination of the Portuguese accelerometer database.

ACCELEROMETER NETWORK

The first strong-motion instruments installed in Portugal were a Japanese SMAC accelerograph on the north pier of Lisbon "25 de Abril" bridge and a SMA-1 Kinemetrics accelerograph at Pico Island (Azores) during the 1960s. These analog instruments provided records on photographic paper for the 1969 M_S 8.0 St. Vincent earthquake, the 1973 Pico Island crisis, and the 1980 M 6.9 Terceira Island earthquake.

The currently operating accelerometer network consists of a set of 32 instruments permanently installed at selected sites, 80% of which are run by Instituto Superior Técnico (IST). Most stations are equipped with GeoSIG SSA-320 force balance tri-axial accelerometers with GSR12, GRS16, or GSR18 digital converter. In addition, there are two Kinemetrics ETNA tri-axial episensor force-balance accelerometers and one Terra Technology integrated digital seismograph (Model IDS-3602) installed. The stations operate in triggered recording mode, with threshold values depending on the station's noise level.

A total of 13 IST instruments are deployed in central and southern Portugal plus 12 in the central group of islands in the Azores archipelago. Figure 1 shows the stations' location. The majority of instruments (about 70%) are installed in the ground level of low-rise buildings (up to three stories). A small number of instruments are deployed in higher levels of taller buildings or in specific structures to evaluate their seismic response. Most stations (73%) are settled in stiff geology sites (classified either as rock or stiff soil).

The instruments were in general funded by research projects, either national or European, and the network has been running with minimum maintenance costs. Besides limited coverage, the main network drawbacks at present are the lack of common timing (GPS) and telemetry to a central station. This last aspect implies not only that there is no real-time access to the data for most stations, but also that data are stored in the instrument memory, meaning that relevant ground motions may not be recorded if the instrument memory fills up.

DATABASE STRUCTURE

The database was implemented in MySQL, a widely used relational database management system (http://www.mysql.com). MySQL server is available as open-source free software and is supported by a large number of system platforms (Windows, Mac OS X, Linux, etc.). Five tables, named according to the information they contain, form the database: three independent tables, *event*, *station*, and *instrument*; and two linked tables, *wave* and *stationlog*. The *event*, *station*, and *instrument* tables describe, respectively, the recorded earthquake characteristics, the database stations, and the instruments. The *sta-*

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Efforts towards data dissemination

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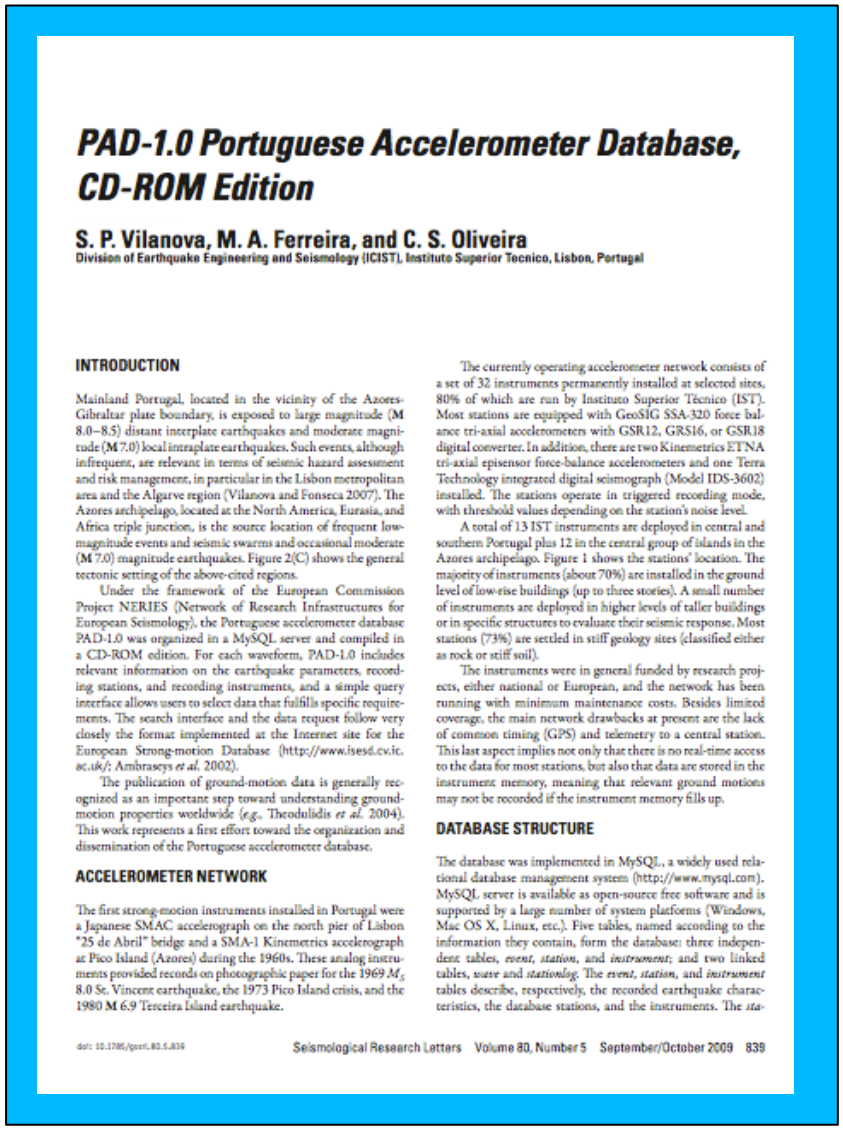
Data up to the end of 2006



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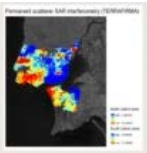

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Data dissemination efforts

For post-2006 data

Data and Resources

Accelerometer data used in this paper were recorded by the accelerometer networks of Instituto Superior Tecnico (IST), Lisbon, and Instituto Geografico Nacional (IGN), Madrid. Data from the most recent earthquakes of 12 February 2007 and 17 December 2009, which are not included in Vilanova *et al.* (2009), are available by request. Broadband velocity waveforms were recorded by the IST seismometer network and by the Instituto de Meteorologia (IM), Lisbon. These data are also available by request. We used intensity values according to Teves-Costa and Battlo (2011) for the 23 April 1909 earthquake, Justo and Salwa (1998) for the 26 January 1531 earthquake, and Moreira (1984) for the 27 December 1722 and the 11 November 1858 earthquakes. For the remaining earthquakes we used intensities values published by the IM. We computed the response spectra using the software developed by D. M. Boore (http://daveboore.com/software_online.html, last accessed November 2011). All figures were plotted using the Generic Mapping Tools version 4.2.0 (http://gmt.soest.hawaii.edu/, last accessed November 2011) developed by Wessel and Smith (1991). The Global Centroid Moment Tensor Project database was searched using www.globalcmt.org/CMTsearch.html (last accessed April 2011).

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Efforts towards data dissemination

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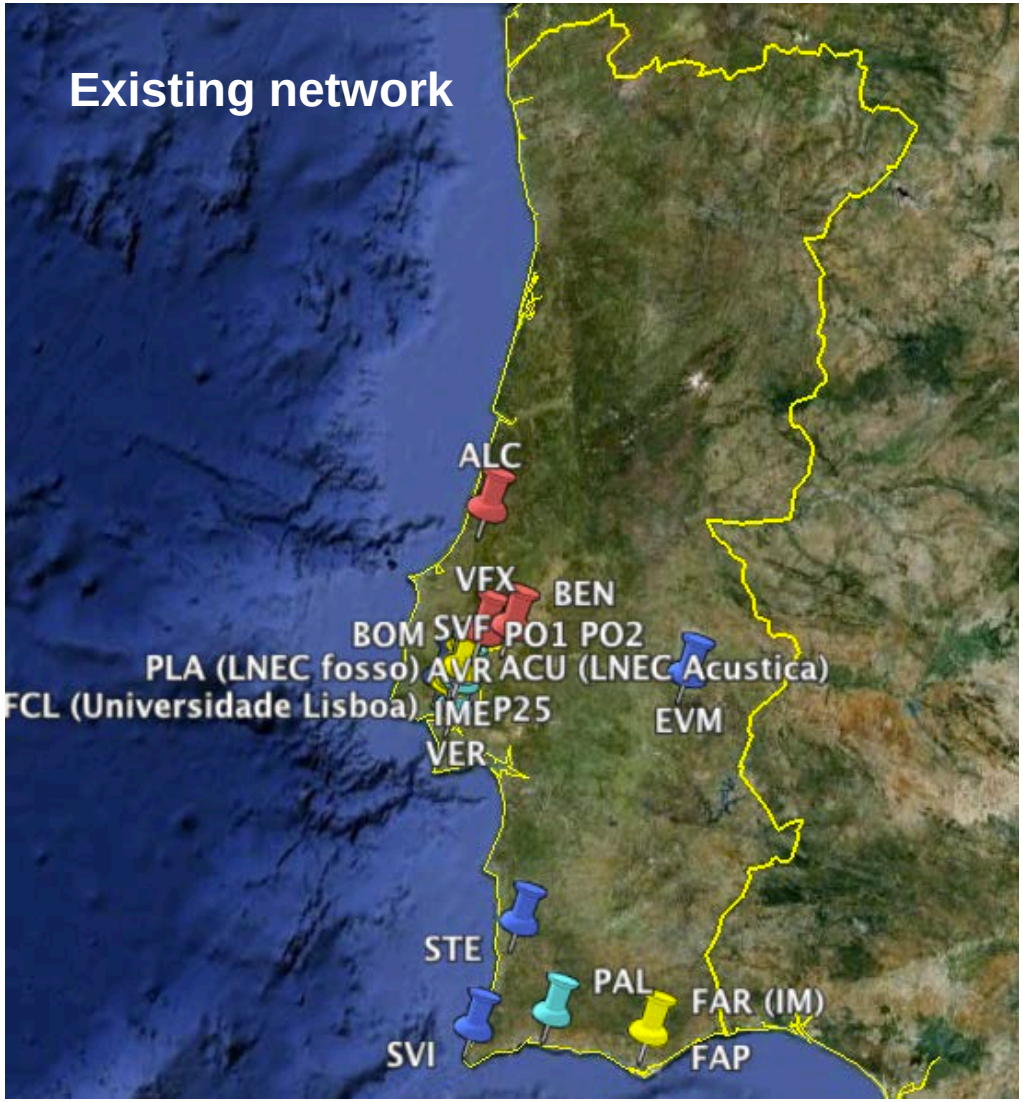
Upgrading the Portuguese network – 2008/2009 onwards

REEQUIPAMENTO

Project funded by the National Foundation for Science and technology



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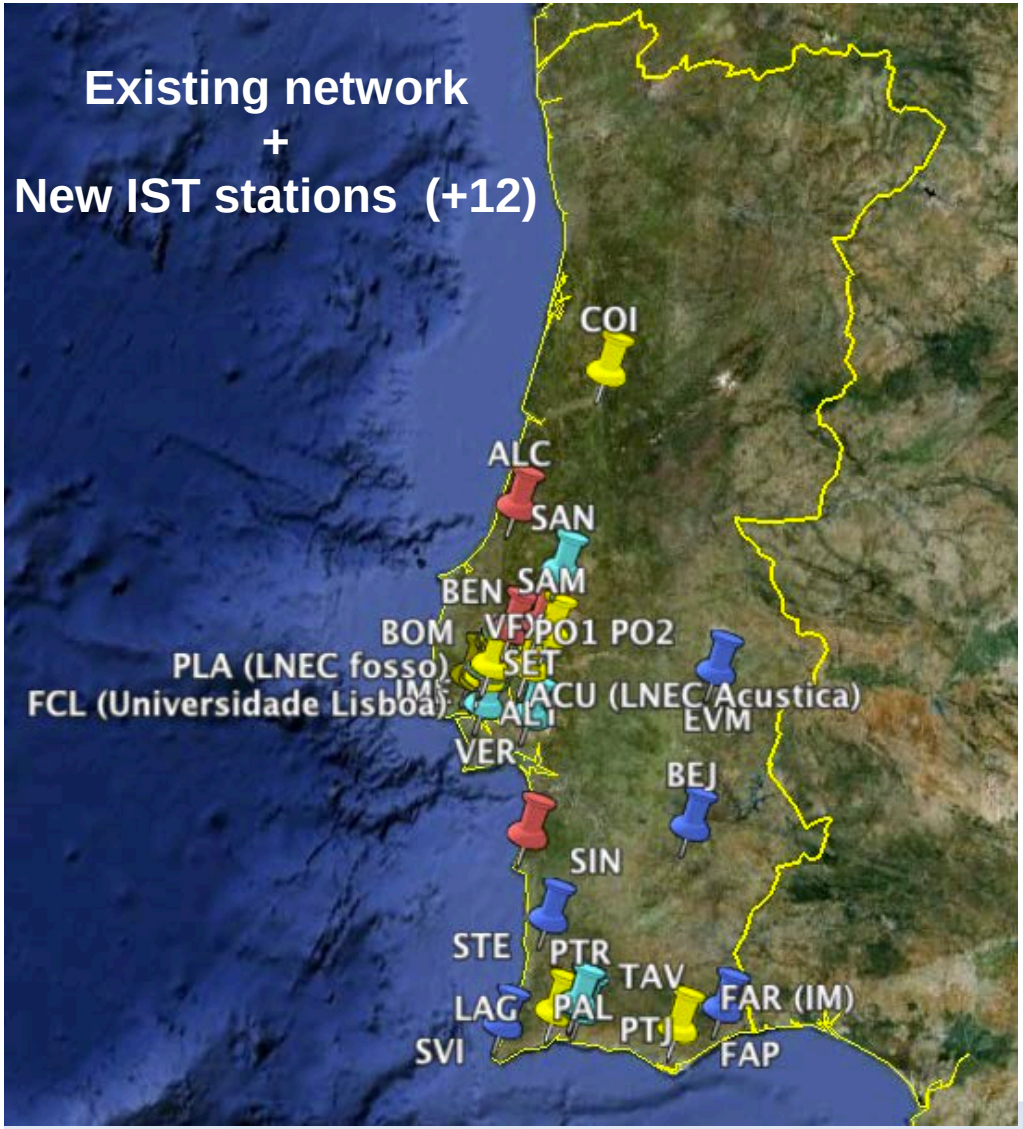

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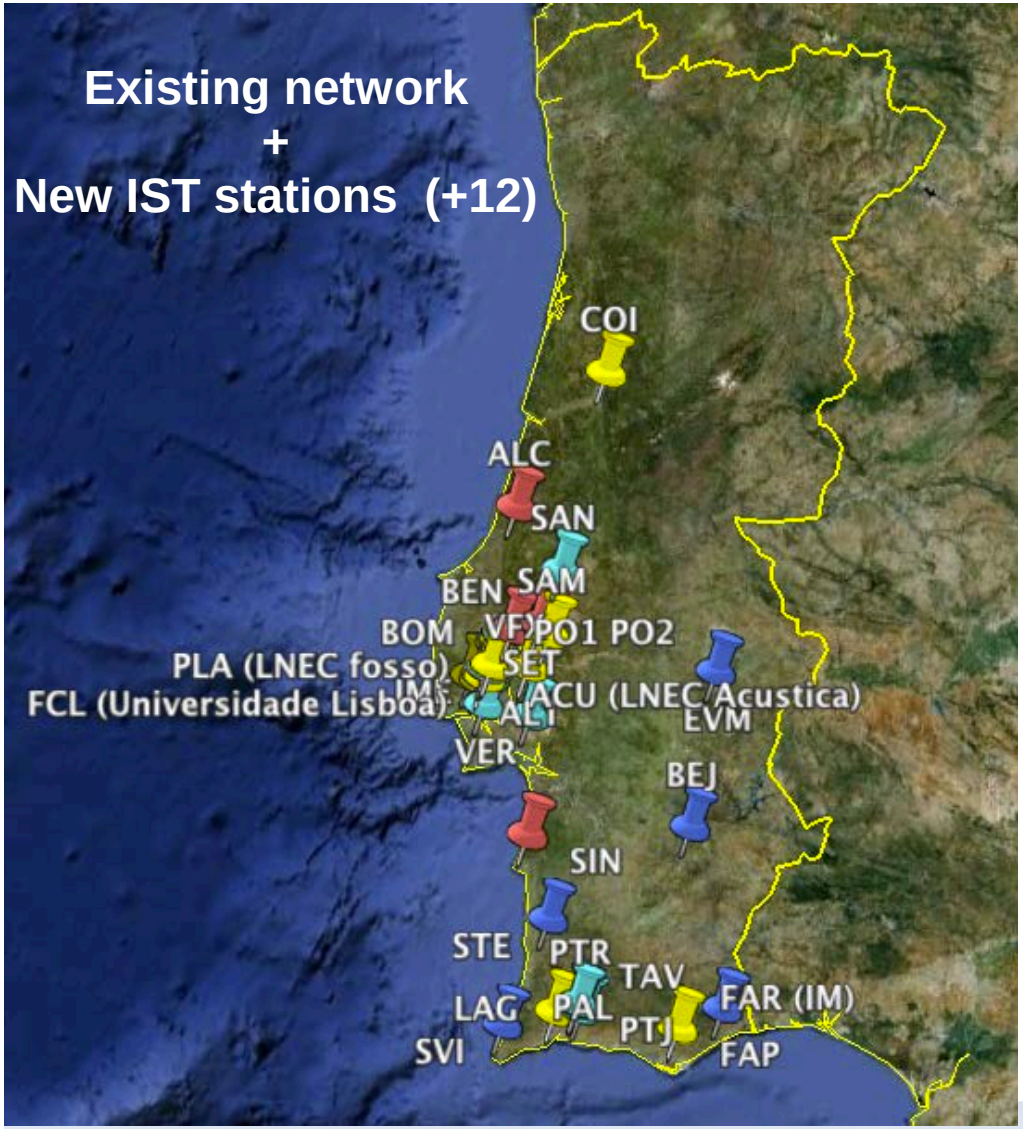

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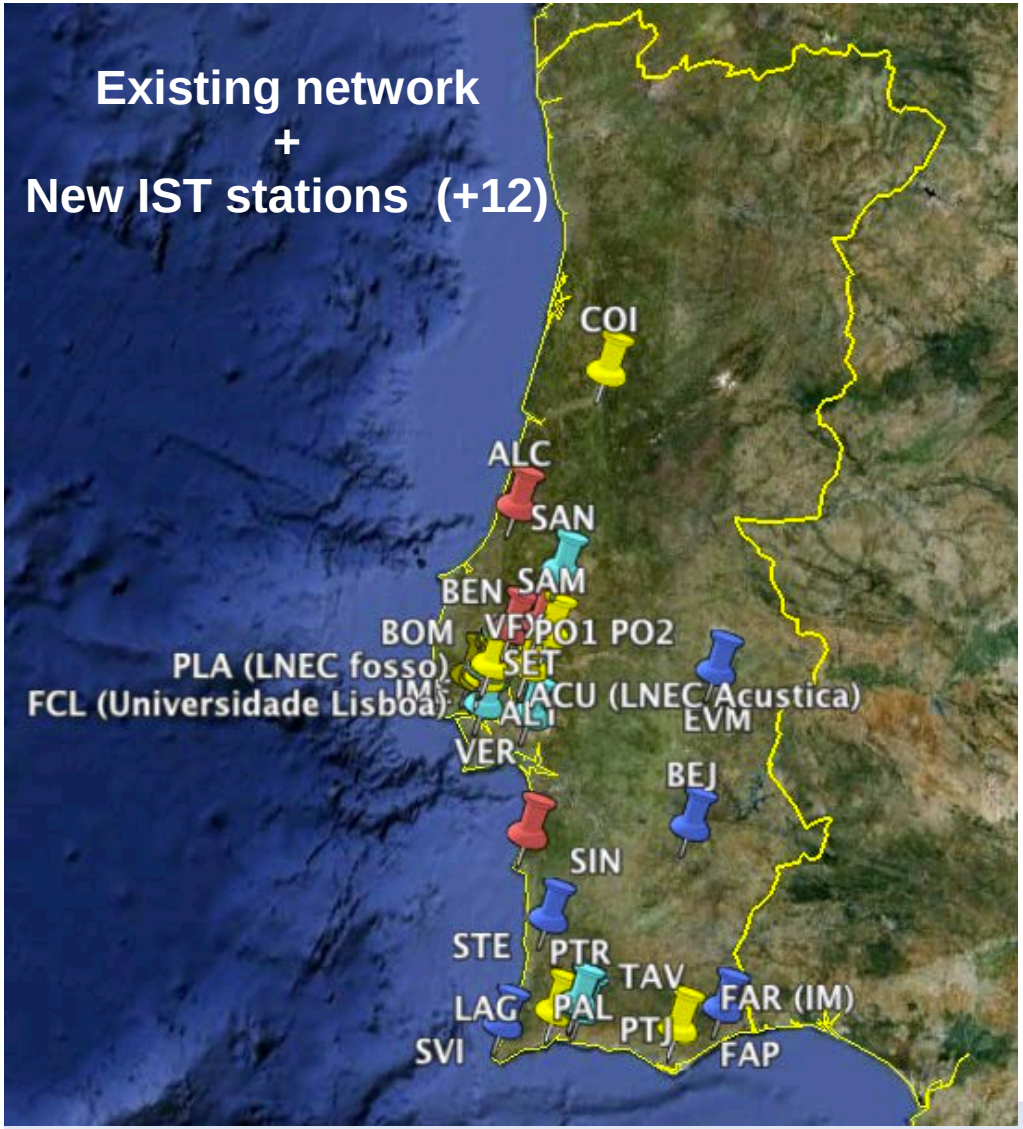

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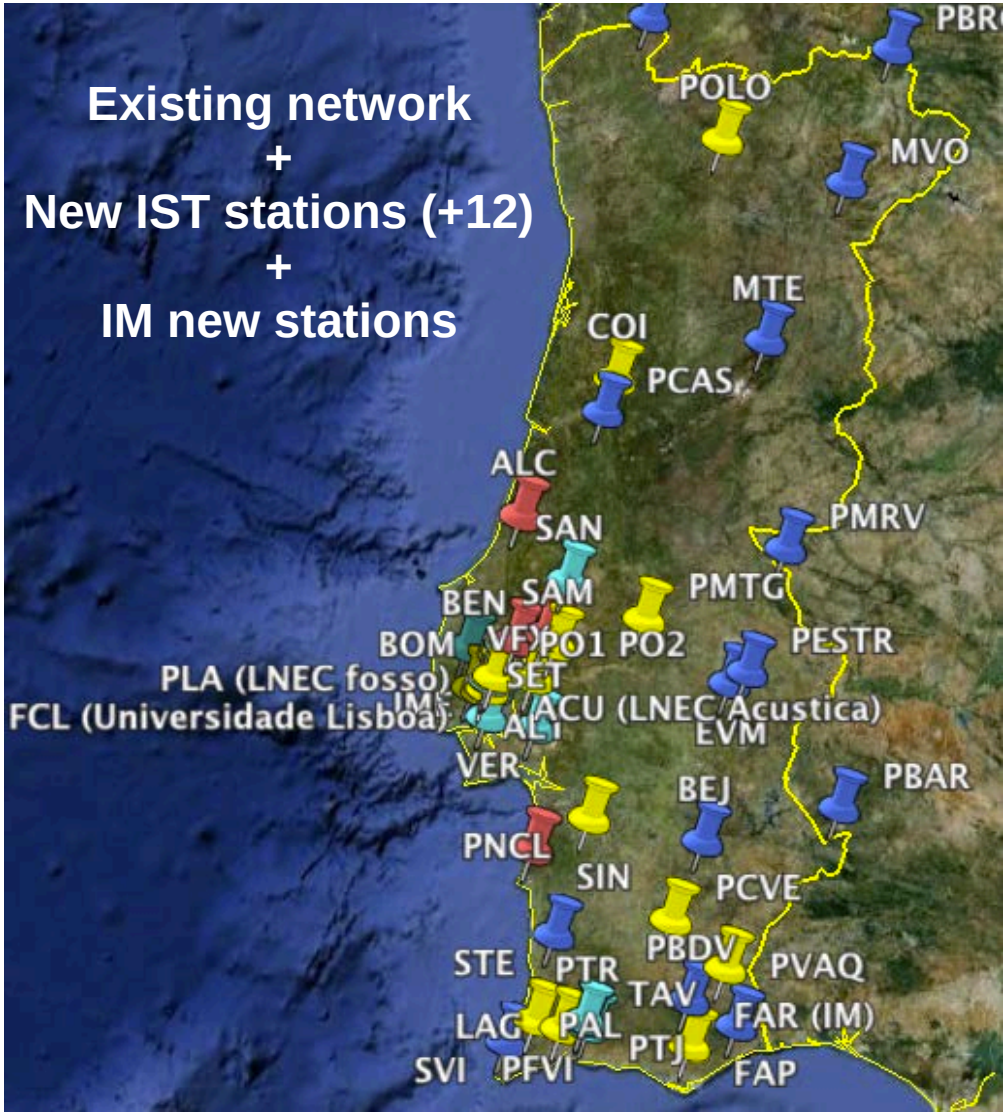
Some remarks:

- IST network covers the areas where moderate to large ground motions are expected to occur

- IM network provides a more regional coverage



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- IM network provides a more regional coverage
- IST network covers a wider range of geological settings
- IM network is mainly located in rock sites (old metamorphic, igneous)