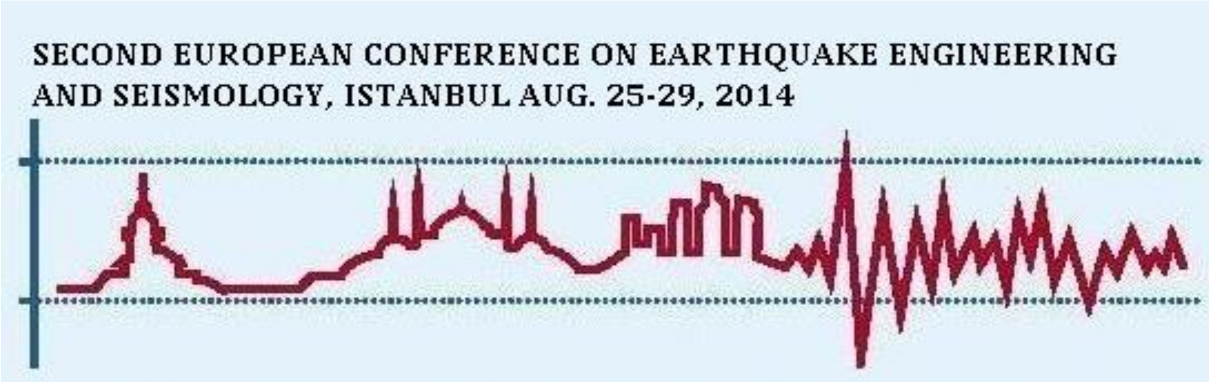

APPLICATION OF SASHA TO SEISMIC HAZARD ASSESSMENT FOR PORTUGAL MAINLAND

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In the frame of the UPStratMAFA "Urban Disaster Prevention Strategies Using MAcroseismic Fields and FAult Sources", probabilistic seismic hazard assessment for Portugal has been performed by using a new version of the SASHA code (D'Amico and Albarello, 2008) on purpose modified to account for this specific area of study. Hazard is estimated in terms of expected intensity values, taking into account the different inputs allowed by SASHA, namely historical information (site documented intensities), attenuation of intensity from the source and results provided by numerical simulations of the expected ground motion.

In more detailed information, the following inputs were considered:

a) A database of macroseismic intensities observed in the area, that has been compiled by gathering macroseismic observations documented in several studies. The compilation of events for offshore and mainland Portugal covers the time period from 1531 to 2007 comprising 23 earthquakes above damage threshold V-VI EMS98 providing a total of 2828 geo-referenced Macroseismic Data Points. The database presents a great heterogeneity in felt reports distribution, existing some localities in Lisbon area with more than 45 felt reports, comparing with a maximum of 15 reports in a locality in the south of Portugal and with a maximum of 2 or 3 reports in most of the councils of Portugal.

b) The Portuguese earthquake catalogue that comprises 342 earthquakes above damage threshold V-VI from 63 B.C to 2007. Due to SASHA methodology, the magnitude of earthquake had to be converted into an epicentral value of intensity. For that purpose, it was used the relation Magnitude-epicentral intensity derived by Casado *et al*. (2000) for Iberia region.

c) The attenuation laws derived in task B of this project (Rotondi *et al*, 2014). It is worthwhile mentioning that two physical mechanisms of earthquake generations exists in Portugal, namely events originated by the movement between the Eurasian and African plates (interplate events) and events originated in faults inside the Eurasian plate (intraplate events). Being so, two different attenuation laws were derived, considering independently the intraplate events database and interplate events database.

d) Synthetic intensities database, obtained through simulation of past events using a stochastic finite.-fault methodology calibrated for Portugal (Carvalho *et al*., 2009). As to diminish the heterogeneity in the macroseismic data, simulations were performed for past events with epicenter offshore that could cause higher damage in the south of Portugal, namely the events of the years 386, 1356 and 1761 with magnitude 7.5 located in the Horseshoe fault.

Hazard was computed for all councils of Portugal mainland, considering virtual intensities (by the used of attenuation laws), felt effects history and simulated intensities, considering for each

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earthquake the nearest macroseismic datum within a distance of 5 km away from the investigated site and all earthquakes within a circle of 500 km radius centered at the site.

Hazard curves for the 12 MCS intensity degrees obtained for three councils located at North (Porto), Centre (Lisbon) and South (Lagos) of Portugal are given in Figure 1.

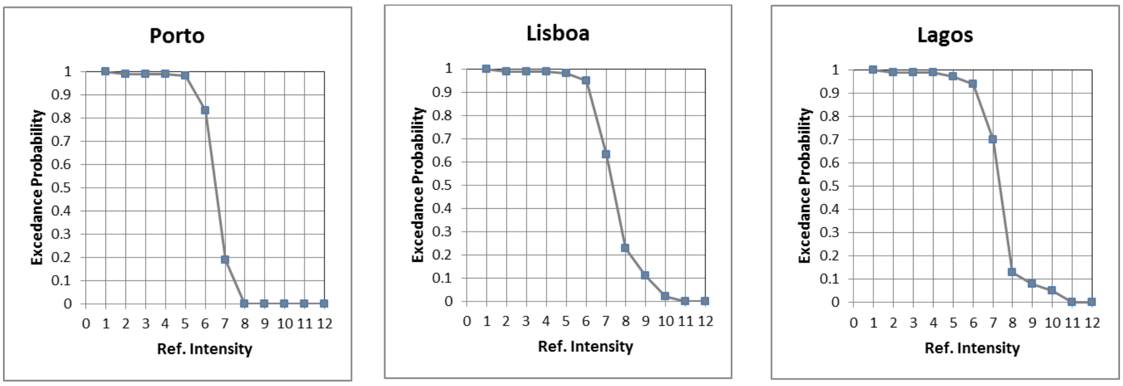

Figure 1. Hazard curves computed at the sites Porto, Lisboa and Lagos

As an output of SASHA, it was performed a disaggregation analysis in order to know the most representative earthquake which contribute to the hazard. The probability values of I_{ref} were binned in classes of epicentral distances (10 km each) and magnitude (0.5 units each). The relevant probability values relative to each earthquake were summed up in the relevant distance/magnitude bin and normalized to provide a disaggregation map.

The results obtained for the site of Porto, Lisboa and Lagos, for a 10% excedance probability in 50 years exposure time are shown in Figure 2. In particular, the hazard for Lisboa (I_{ref} = IX) is due mainly by earthquakes close to the site (up to 20 kilometres from), with a very small contribution to larger and more distance earthquakes.

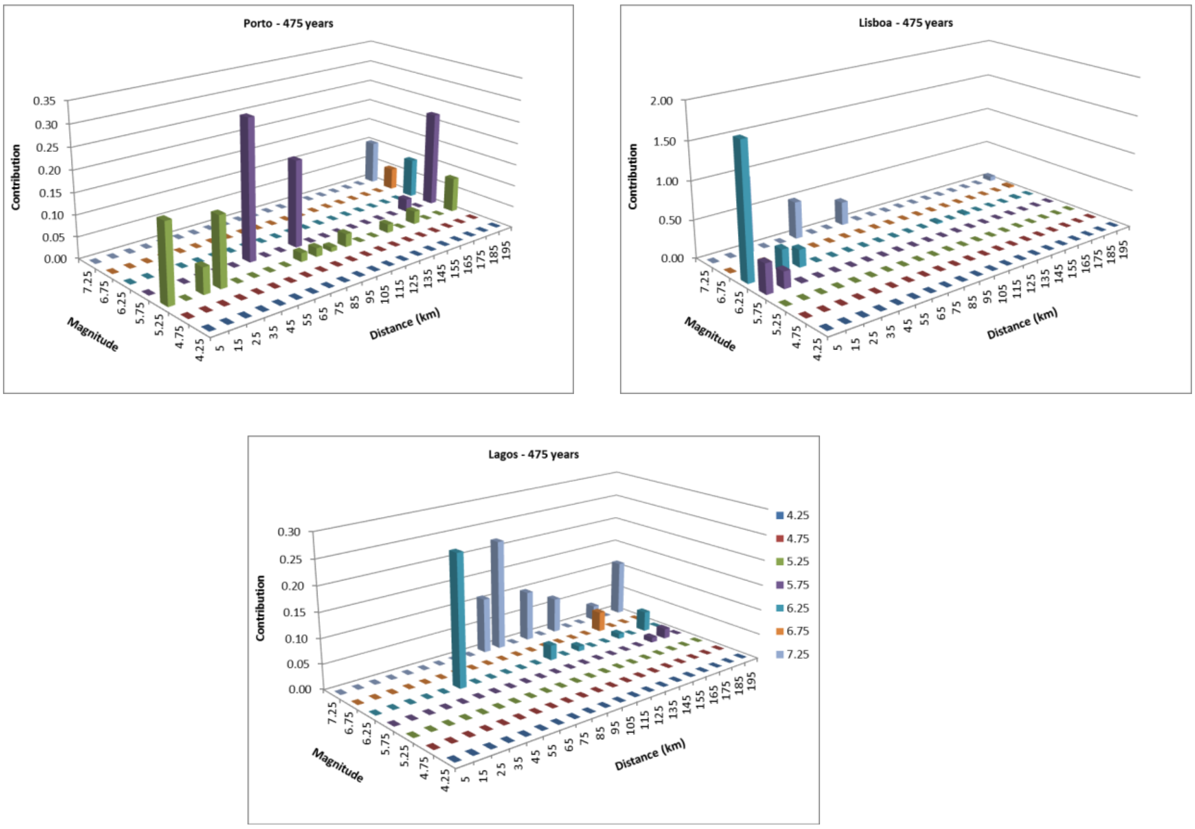

Figure 2. Disaggregation Magnitude Vs. Distance for Porto, Lisboa and Lagos, 10% probability of excedance and 50 years exposure time.

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