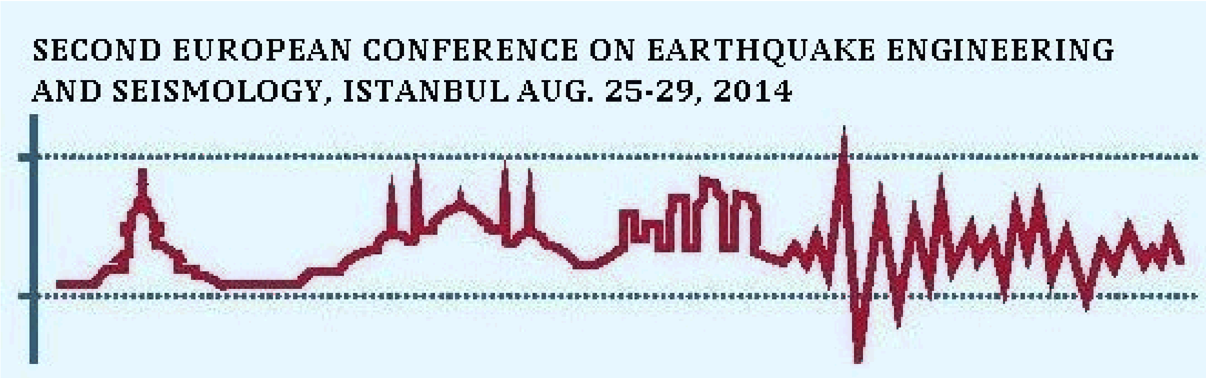

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VERTICAL GROUND MOTIONS IN NE ITALY

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Recent earthquakes, especially that of May 22, 2012 in the Ferrara region (northern Italy), have clearly pinpointed the effects of the vertical ground motions, especially in the near field. In fact, the most severe damage suffered by the industrial buildings was caused by a vertical peak ground acceleration (PGA) around 1 g, not expected in that area according to the present Italian seismic code. More examples can be found worldwide, see e.g. Papazoglou and Elnashai (1996), Yang and Sato (2000), Elgamal and He (2004), and Aghabarati and Tehranizadeh (2009).The majority of the building codes presently applied in the European countries consider simply an empirical scaling factor between horizontal and vertical accelerations.

This aspect increases additionally the uncertainty in ground motion estimation in the near field, where also horizontal shakings are not properly modelled because of lack of a robust calibration of the ground motion prediction equations (GMPEs) for short distances. The most important limit in the definition of almost all GMPEs is, in fact, represented by the scarcity of instrumental recordings in the near field. This fact determines that almost all GMPEs are not calibrated for distances less than 20 km. Conversely, the recent Ferrara earthquake, together with its aftershocks, has provided a huge amount of data in the near field. These data, furthermore, have clearly shown that the vertical peak ground acceleration (PGA) can be similar to, or even larger than, the horizontal one. Moreover, the spectral shape that the cited GMPEs forecast is quite different in the high frequency range.

Perhaps for the above reasons or, more probably, because the vertical shaking has been considered of secondary importance in engineering seismology, seismic hazard maps in terms of vertical quantities [PGA and spectral accelerations (SA)] are still not very popular, although vertical GMPEs are available in the literature (e.g., Ambraseys and Simpson 1996, Ambraseys et al., 2005; Akkar and Bommer, 2010).

In this work, a probabilistic seismic hazard assessment (PSHA) in terms of vertical PGA and SA has been performed for the Friuli – Venezia Giulia region, in north-eastern Italy, on the basis of a logic tree already applied for a similar analysis (Slejko et al., 2011). More precisely, among the several vertical GMPEs suitable for PSHA in north-eastern Italy, we have chosen one of global applicability (e.g., Cauzzi and Faccioli, 2008), one calibrated on European data (e.g., Ambraseys and Simpson, 1996), and one specifically computed for the Italian territory (e.g., Bindi et al., 2011) while the remaining branches mimic those of Slejko et al. (2011). Moreover, we have considered the possible variability in the expected ground motion in the near field by introducing a sort of empirical correction in the GMPEs, derived from the near field evidence during the Ferrara earthquakes. The logic tree here

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applied consists, then, of 36 branches (3 zonations, 2 seismicity models, 2 models for maximum magnitude, and 3 GMPEs).

The different maps highlight the characteristics of the expected shaking and the influence of the uncertainty in the major input information is quantified by a proper indicator [COV: Cramer et al. (2002)].

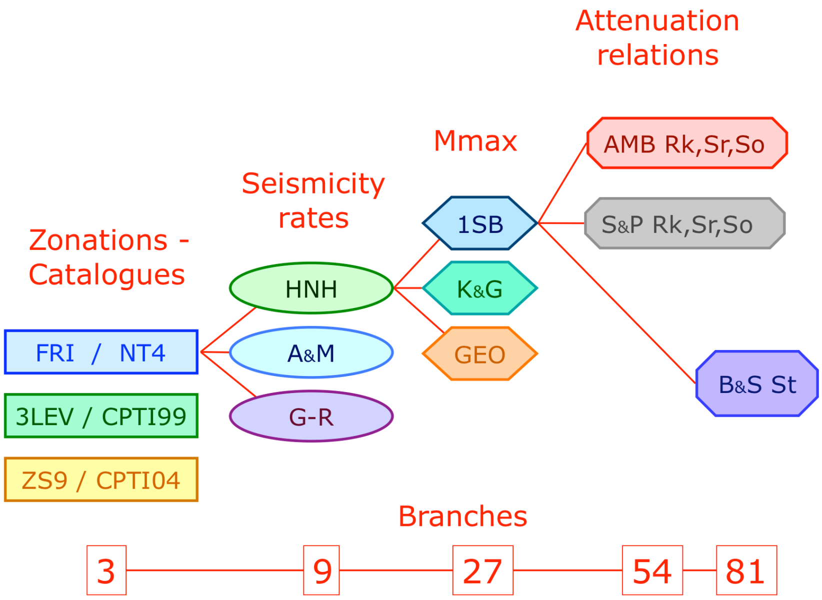

Figure 1. Logic tree used for the PSHA

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