# Applicazione del metodo a sismicità diffusa – App.4 al Rapporto Conclusivo

***a cura di A. Akinci*** *(marzo 2004)*
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## Seismic Hazard Estimate Using Smoothed Historical Seismicity and Regionalized Predictive Ground-Motion Relationships

According to the working programme and to the suggestions of the reviewers a probabilistic seismic hazard assessment (PSHA) has been performed for Italy by using a methodology that follows the procedure originally described by Frankel (1995).
The approach of using spatially-smoothed historical seismicity is different from the one used previously for instance by Slejko et al. (1998), Romeo et al. (2000) and in this research, in which source zones are drawn on the basis of tectonic and seismological information. In its purest form, the smoothed-seismicity method simply assumes that patterns of historical earthquakes predict future activity. The maps obtained in this study are based on the assumption that the process of earthquake occurrence is inherently Poissonian, so that the probability of occurrence is time-independent. Even though in the approach by Frankel (1995) no seismicity source zones are needed, some model parameters can be taken as homogeneous throughout regional sub-zones. The Italian region is subdivided into six macro zones on the main basis of the different rupture mechanism (Montone et al., 2003), seismotectonic model (Meletti et al., 2000), and tectonic and geologic homogeneity (Vai, 2001, Bigi et al., 1992, Funiciello et al., 1981) of the region (fig.1). Each of these macro zones is characterized by a specific attenuation relationship (see App.3, p.11, fig.9a) (Akinci et al., 2004).

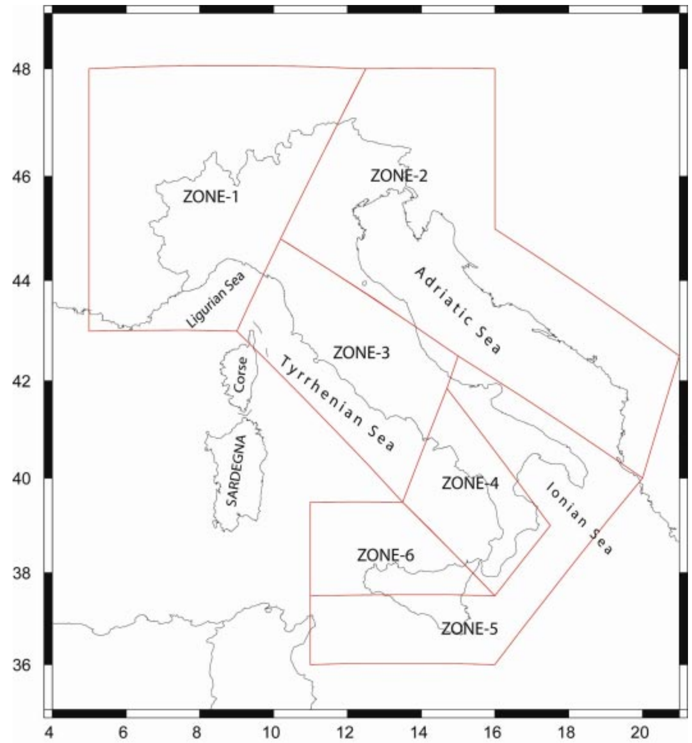


Figure 1. Regionalization used for the ground-motion relationships.

In this application the distribution of the a-value over the Italian region is calculated from the historical seismicity using the declustered catalogue CPTI2 (App.1) which contains 2550 records of earthquakes in the time window 217BC - 2002AD. The time-intervals of stationarity/completeness of the CPTI2 catalogue were identified for different magnitude ranges were taken from the results supplied at par.6.

In order to calculate the seismic hazard in each macro zone, the area is divided into cells 0.1° in latitude by 0.1° in longitude (roughly 10x10km). In each cell the earthquakes in several completeness time-intervals are counted to obtain the a-value distribution in six zones. Mwmin is taken as 4.8Mw ($N_{total}$=1344).

The a value specifies the seismicity rate in an exponential G-R frequency-magnitude distribution (log N=a-bM, where N is the number of events with magnitude equal to or greater than M, and b is the slope of the distribution that describes the relative frequency of small and large magnitudes).

The b-value for each macro zone was determined separately using the maximum likelihood method since it is generally considered statistically more efficient and less dependent upon the few events observed in high magnitude bands (Bender, 1983). Results are given in table 1.

| | ZONE1 | ZONE2 | ZONE3 | ZONE4 | ZONE5 | ZONE6 |
|---|---|---|---|---|---|---|
| CO-04.1. | -1.26 | -1.17 | -1.10 | 0.74 | -0.81 | -1.04 |
| CO-0.43 | -1.29 | -1.17 | -1.23 | -0.75 | -0.84 | -1.07 |

Table 1. b-*values* in each macro zone.

Then the gridded values of $10^a$ (earthquakes/cell/year) are computed and smoothed spatially by a two-dimensional Gaussian function with correlation distance of 25km in each macro zone. This optimal correlation distance for Italy was obtained by Console and Murru (2001) using a trial-and-error procedure.

Finally, the annual rate of exceeding a specified ground motion at a site is calculated from a double summation over distance and magnitude, using suitable ground motion relationships and uncertainties. For the purpose of this study the attenuation dataset called REG.A (par.5 and App.3) was used with a maximum source-site distance of 150km.

The results obtained are maps of peak horizontal acceleration with 10% probability of exceedance in 50 years (return period of 475 years). The maps show high probabilistic accelerations ≥0.28g in the Friuli region, central-southern Apennines and in the Calabria. The lowest PGA, around 0.10g, is observed in the western and Maritims Alps (fig.2).

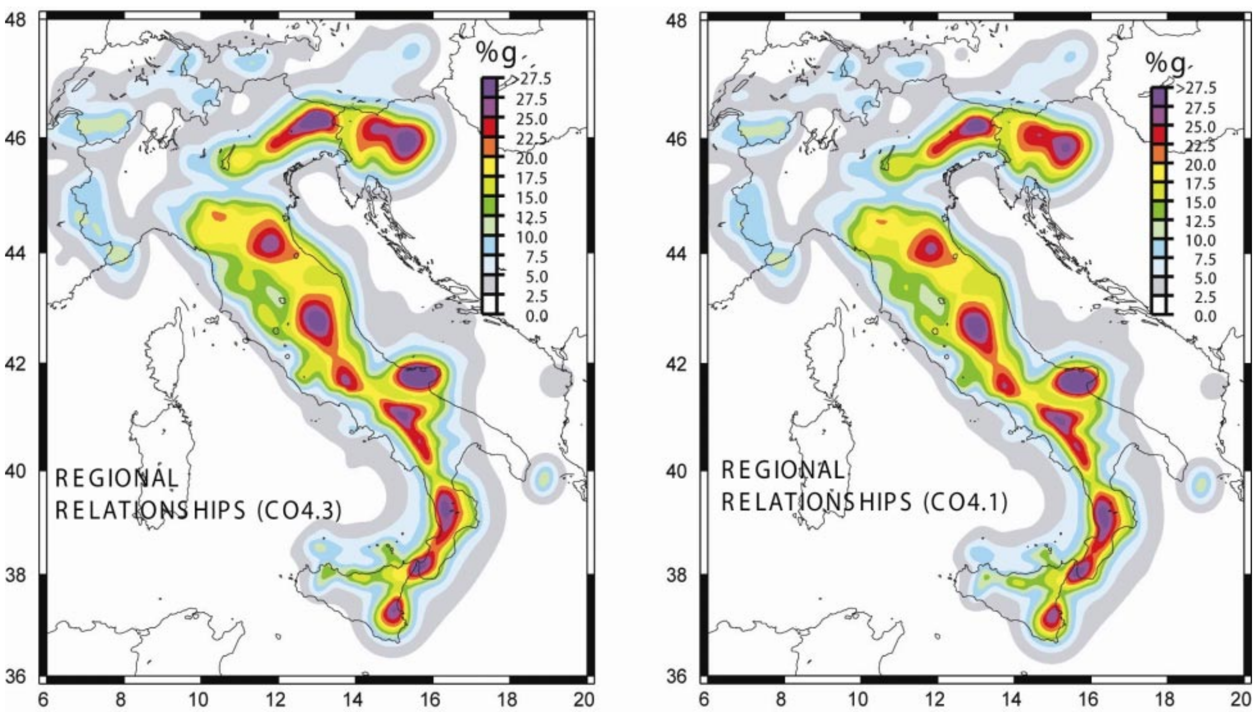


Figure 2. The peak horizontal acceleration maps with 10% probability of exceedence in 50 years (return periods of 475 years) derived from the grid of 10[a] values in Italy. Calculations are done using the CO-04.1 and CO-04.3 completeness of CPTI2 and using the REG.A attenuation dataset.

## References

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