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Natural Hazards and Earth System Sciences
Discussions



# *Interactive comment on* "A scoring test on probabilistic seismic hazard estimates in Italy" *by* D. Albarello et al.

**D. Albarello et al.**

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The reviewer solicits two important points that have been only marginally tackled in the paper, and are going to be discussed soon during a specific workshop (http://www.eucentre.it/workshop-on-testing-psha-results-and-benefit-of-bayesian-techniques-for-seismic-hazard-assessment/). We anticipate some of the material to the attention of the referee. The text has been only slightly modified for warning the readers of the problems, and for addressing the forthcoming papers.

1) Completeness is always a thorn in the flesh. We estimated the "uncompleteness" of our maximum observed PGA by comparing observed PGA (as given by the ITACA v.1.0 release, available at the moment of elaborations the paper refer to) with theoreti-



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cal values obtained by using the Italian earthquake catalogue CPTI11 and GMPE from Italian data (Bindi et al., 2011), using differentiated soil type accordingly with stations classes. The maximum computed value in the reference period (1979-2004) is taken if the (mean – 1sd) exceed the sensitivity threshold of accelerometric stations of that period, commonly assigned at 0.01 g. Figure 1 represents the available data, sorted for increasing values of observed minus calculated PGA. Note that about 50% of the stations have positive residuals thus implying that the observations exceed the theoretical calculated values; among those having negative residuals, only for four stations (ARI, SRP, LNG, MRN; 4 on 71 station<6%) uncompleteness should be invoked in observations (no records), even if the expected values (40-60 cm/s2) are still inside an acceptable intrinsic variability due to source/site effects. In order to evaluate the possible role of this incompleteness on our results, a sensitivity test was performed to check the effects of different levels of incompleteness on the final scores. To this purpose, a large number of artificial data sets was generated by a Monte Carlo procedure including a randomly varying number of "incomplete" stations. In each run, "Incomplete" stations were randomly selected with a fixed probability (0.05, 0.1, . . .) representative of the relevant incompleteness level. When the single station is considered to be affected by incompleteness, the maximum acceleration actually observed was substituted by the sensitivity threshold (9.8 cm/s2). For each "artificial" data set, the score was obtained by comparing "observations" with forecasts. In this way, the average "scores" (e.g., the number exceedances) was obtained for each "incompleteness" probability. The average score and the respective standard deviation has been than associated to each "incompleteness" level (e.g. incompletes probability). This analysis shows that, final results are not significantly affected by incompleteness levels lower than 20%.

2) The second point raised by the referee concerns a basic assumption of the PSHA; the method states that mutually independent events (earthquakes) have to be accounted for to satisfy Poisson statistics. Nonetheless, the basic outcome of any PSHA is the maximum ground shaking one can reasonably (i.e. at any fixed probability) expect, irrespective to the fact that this threshold is eventually overcome by any main-



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shock or other events. Actually, we cannot provide an anti-seismic design for mainshocks only, leaving the structure unprotected against the effect of an aftershock! The fact that the PSHA has been performed by assuming independent events only, does not hamper the actual occurrence of strong aftershocks responsible for PGA values larger than the one resulting from the considered model. If this occurs many times, it simply means that the "forecast" was wrong and the "maximum acceleration" resulting from the considered PSHA simply underestimates the hazard. In the application we did, the maximum observed PGA in 25 years is retained, no matter if recorded during the mainshock, or in a "dependent" event of a large sequences. We know also that some maxima are related to minor earthquakes,the most astonishing case at station DMN, with more than 200 cm/s2 for a M$\sim$3.0 event (not reported in the CPTI11 catalogue). What we are testing is effectiveness of the single PSHA model: we cannot change the world to fit our requests. It should be better changing the model to fit actual seismicity.

Finally, the term methodology has been removed from the text and substituted with "methods".

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 2, 5721, 2014.





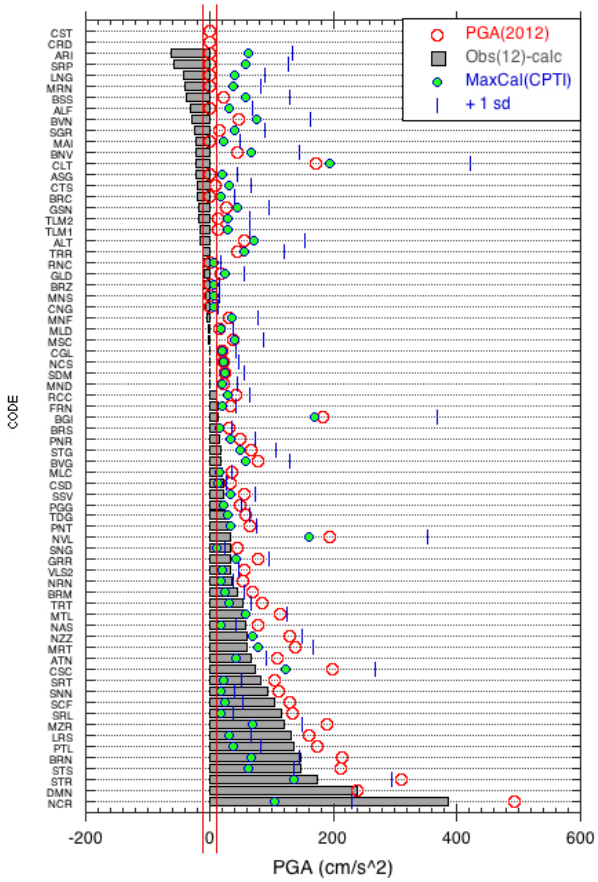


**Fig. 1.** Check on completeness of observations, for Ref. #2



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