



Strong motion recordings of the 2008/12/23 earthquake in Northern Italy: another case of very weak motion?

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On December 23 2008 an earthquake of magnitude $ML=5.1$ (INGV) $Mw=5.4$ (INGV-Harvard Global CMT) occurred in northern Italy close to the cities of Parma and Reggio Emilia. The earthquake, with a macroseismic intensity of VI MCS, caused a very slight damage (some tens of unusable buildings and some hundreds of damaged buildings), substantially lower than the damage estimated by the loss simulation scenario currently used by the Italian Civil Protection.

Due to the recent upgrading of the Italian strong motion network (RAN), the event has been recorded by a great number of accelerometers (the largest ever obtained in Italy for a single shock): 21 digital and 8 analog instruments with epicentral distances ranging from 16 to 140 km. The comparison of recorded PGA, PGV, Arias intensity, and spectral values with several widely used Ground Motion Prediction Equations (GMPEs) showed much lower ground motion values respect to the empirical predictions (a factor ranging from 4 to 2).

A first explanation of the strong differences, in damage and ground motion, between actual data and predictions could be, at a first sight, attributed to the rather high focal depth of 27 km. However, even the adoption of GMPEs accounting for depth of the source and using hypocentral distance (Berge et al 2003, Pousse et al 2005), does not predict large differences in motions, especially at distances larger than 30 km where most of the data are concentrated and where the effect of depth on source-to-site distance is small. At the same time the adoption of the most recent GMPEs (Ambraseys et al 2005, Akkar & Bommer 2007) taking into account the different magnitude scaling and the faster attenuation of small magnitudes through magnitude-dependent attenuation, does not show a better agreement with the recorded data.

The real reasons of the above mentioned discrepancies need to be further investigated, however a possible explanation could be a low source rupture velocity, likewise the 2002 Molise earthquake that also generated very weak motions. Another explanation comes from the fact that the moment magnitude estimated by the INGV network on the basis of body-waves instead of surface-waves used by Harvard CMT, is 4.9 and not 5.4, providing a much better fit of recorded ground motions with GMPEs.