Geophysical Research Abstracts
Vol. 17, EGU2015-2497, 2015
EGU General Assembly 2015


# Probabilistic versus deterministic hazard assessment in liquefaction susceptible zones

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Probabilistic seismic hazard assessment (PSHA), usually adopted in the framework of seismic codes redaction, is based on Poissonian description of the temporal occurrence, negative exponential distribution of magnitude and attenuation relationship with log-normal distribution of PGA or response spectrum. The main positive aspect of this approach stems into the fact that is presently a standard for the majority of countries, but there are weak points in particular regarding the physical description of the earthquake phenomenon. Factors like site effects, source characteristics like duration of the strong motion and directivity that could significantly influence the expected motion at the site are not taken into account by PSHA.
Deterministic models can better evaluate the ground motion at a site from a physical point of view, but its prediction reliability depends on the degree of knowledge of the source, wave propagation and soil parameters.
We compare these two approaches in selected sites affected by the May 2012 Emilia-Romagna and Lombardia earthquake, that caused widespread liquefaction phenomena unusually for magnitude less than 6. We focus on sites liquefiable because of their soil mechanical parameters and water table level. Our analysis shows that the choice between deterministic and probabilistic hazard analysis is strongly dependent on site conditions. The looser the soil and the higher the liquefaction potential, the more suitable is the deterministic approach. Source characteristics, in particular the duration of strong ground motion, have long since recognized as relevant to induce liquefaction; unfortunately a quantitative prediction of these parameters appears very unlikely, dramatically reducing the possibility of their adoption in hazard assessment.
Last but not least, the economic factors are relevant in the choice of the approach. The case history of 2012 Emilia-Romagna and Lombardia earthquake, with an officially estimated cost of 6 billions Euros, shows that geological and geophysical investigations necessary to assess a reliable deterministic hazard evaluation are largely justified.