Geophysical Research Abstracts
Vol. 15, EGU2013-3919, 2013
EGU General Assembly 2013

How long time will we go with linear seismology?

Gheorghe Marmureanu, Carmen Cioflan, Alexandru Marmureanu, and Bogdan Apostol
National Institute for Earth Physics, Bucurest, Romania (marmur@infp.ro)

Motto: The nonlinear seismology is the rule,
The linear seismology is the exception.
Paraphrasing Tullio Levi-Civita

The leading question is: how many cities, villages, metropolitan areas etc. in seismic regions are constructed on rock sites? Most of them are located on alluvial deposits/ sediments, on Quaternary layers or in river valleys. In last book written by Peter M. Shearer, Professor of Geophysics at University of California, we can find, in total, only 12 rows about non-linear seismology(page 176).Among others are the following conclusions:(i)-Strong ground accelerations from large earthquakes can produce a non-linear response in shallow soils; (ii)-When a non-linear site response is present, then the shaking from large earthquakes cannot be predicted by simple scaling of records from small earthquakes; (iii)-This is an active area of research in strong motion and engineering seismology. On the other hand, Aki wrote: Nonlinear amplification at sediments sites appears to be more pervasive than seismologists used to think... Any attempt at seismic zonation must take into account the local site condition and this nonlinear amplification(Aki, A., Local Site Effects on Weak and Strong Ground Motion, Tectonophysics,218,93-111,1993). The difficulty to seismologists in demonstrating the nonlinear site effects has been due to the effect being overshadowed by the overall patterns of shock generation and propagation. In other words, the seismological detection of the nonlinear site effects requires a simultaneous understanding and separating of the effects of earthquake source, propagation path and local geological site conditions. To see the actual influence of nonlinearity of the whole system (seismic source-path propagation-local geological structure) the authors used to study the response spectra because they are the last in this chain and, of course, that they are the ones who are taken into account in seismic design of all structures Stress-strain relationships for soils are usually nonlinear, soil stiffness decreases and internal damping increases with increasing shear strain during of strong earthquakes. There is a strong nonlinear dependence of the spectral amplification factors(SAF) on earthquake magnitude for all seismic stations on Romanian territory on extra-Carpathian area (Iasi, Bacau, Focsani, Bucharest etc.). Median values of SAF for last strong Vrancea earthquakes are decreasing from 4.16(May 31,1990;Mw=6.4),to 3.63 (May 30,1990;Mw=6.9) and to 3.26 (August 30, 1986; Mw=7.1) .The novelty and the complexity degree comes from the fact that for first time, the final decision for NPP Cernavoda site was also based on local strong nonlinear spectral amplifications for strong earthquakes and used in last „STRESS TEST" asked by IAEA Vienna in 2011. The present analysis indicates that the effect of nonlinearity could be very important and if the analysis is made for peak accelerations, it is 48.87% and for stronger earthquakes it will be bigger. The authors are coming with new recorded data which will open up a new challenge for seismologists studying nonlinear site effects in 2-D and 3-D irregular geological structures, leading them to a fascinating research subject in earth physics(Aki,1993, p.108,idem),in nonlinear seismology and,finally, in a real evaluation of earthquake risk and loss estimates.