Geophysical Research Abstracts
Vol. 20, EGU2018-7637-1, 2018
EGU General Assembly 2018

Analysis of 3D simulated seismic wavefields in the media modified by the underground nuclear explosion with the vertical emplacements

Miriam Kristekova (1,2), Jozef Kristek (1,2), Peter Moczo (1,2), Martin Galis (1,2), and Peter Labak (3)

(1) Earth Science Institute, Slovak Academy of Sciences, Bratislava, Slovakia, (2) Comenius University Bratislava, Faculty of Mathematics, Physics and Informatics, Bratislava, Slovakia, (3) CTBTO, Vienna, Austria

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans nuclear explosions worldwide. The CTBT has a unique and comprehensive verification regime to make sure that no nuclear explosion goes undetected. On-site inspections (OSI) belong to the important pillars of this regime. Further development of the OSI capabilities includes also initial elaboration of the resonance seismometry as one of the treaty's permitted techniques. Proper understanding of the resonance seismic phenomena in the underground structure beneath epicentre of an underground nuclear explosion (UNE) is the first necessary step for a potential identification of these phenomena in seismic records acquired at and near the site. Numerical simulation of seismic wave fields in realistic models of the underground structure and analysis of the synthetic seismograms is one possible approach to find out whether resonance phenomena in different conditions produce identifiable robust and reliable characteristics of the surface seismic motion.

In collaboration with the CTBT Organisation we investigate possibilities of the resonance seismometry using 3D modelling of seismic wave fields in realistic models of the underground structure after an UNE. We have developed a set of structural models for the vertical emplacement considering a) two yields of the UNE (1 kt and 10 kt), b) four different material parameters of the pre-shot geological environment (tuff, alluvium, granite, rock salt), c) two extreme cases of the depth of burial (minimal and 2-times minimal). We estimated geometrical and material parameters of the models based on extensive review of the available literature. We estimated geometrical parameters with uncertainties quantified by standard deviations. This made it possible to consider a variety of models. The models include cavity, chimney with apical void, rubble zone, crushed zone, fractured zone and free surface.

For the developed set of the models we performed an extensive numerical simulations of seismic wavefields due to plane-wave excitation using forward 3D finite-difference method.

We present results of the analysis of the 3-component simulated seismic waveforms at the large set of receivers for all models. We analysed the simulated waveforms in the time, frequency and time-frequency domains in order to identify those characteristics of seismic ground motion that could be related to resonance phenomena caused by cavity, chimney and surrounding structure changed after UNE.