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Analysis of the seismic wavefield in the Moesian Platform (Bucharest area)

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Bucharest is located in the center of the Moesian platform, in a large and deep sedimentary basin (450 km long, 300 km wide and in some places up to 20 km depth). During large earthquakes generated by the Vrancea seismic zone, located approximately 140 km to the North, the ground motion recorded in Bucharest area is characterized by predominant long periods and large amplification. This phenomenon has been explained by the influence of both source mechanism (azimuth and type of incident waves) and mechanical properties of the local structure (geological layering and geometry).
The main goal of our study is to better characterize and understand the seismic wave field produced by earthquakes in the area of Bucharest.
We want to identify the contribution of different seismic surface waves, such as the ones produced at the edges of the large sedimentary basin or multipath interference waves (Airy phases of Love and Rayleigh waves) to the ground motion.
The data from a 35 km diameter array (URS experiment) installed by the National Institute for Earth Physics during 10 months in 2003 and 2004 in the urban area of Bucharest and adjacent zones was used.
In order to perform the wave field characterization of the URS array, the MUSIQUE technique was used. This technique consists in a combination of the classical MUSIC and the quaternion-MUSIC algorithms and analyzes the three-component signals of all sensors of a seismic array together in order to analyze the Love and Rayleigh wave dispersion curves as well as the Rayleigh wave ellipticity curve.
The analysis includes 20 regional earthquakes with Mw >3 and 5 teleseismic events with Mw> 7 that have enough energy at low frequency (0.1 - 1 Hz), i.e. in the resolution range of the array.
For all events, the greatest energy is coming from the backazimuth of the source and the wave field is dominated by Love waves. The results of the array analyses clearly indicate a significant scattering corresponding to 2D or 3D effects in the Moesian Platform. The backazimuth distribution of energy shows that the scattering comes primarily from the southern and northern edges of the basin.
The Airy phases of Love waves were identified in the direction of the backazimuth and its reflection around the fundamental frequency (0.15 - 0.25 Hz).
Love and Rayleigh wave dispersion curves are successfully retrieved after combining the records of all events, and show a good match with the ones obtained in previous studies using ambient vibration measurements. Additionally, the first higher mode of Rayleigh waves was retrieved using earthquakes records. We could also identify the Rayleigh wave ellipticity curves, distinguishing between prograde and retrograde particle motion.