



Evidence of slope response directivity from ambient noise and accelerometer data acquired in the town of Qiaozhuang, China

Vincenzo Del Gaudio (1), Yonghong Luo (2), Sandro Muscillo (1), Runqiu Huang (2), Yunsheng Wang (2), and Janusz Wasowski (3)

(1) Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", Bari, Italy, (2) State Key Laboratory of Geo-Hazard Prevention and Geo-Environment Protection, Chengdu University of Technology, Chengdu, P.R. China, (3) CNR-IRPI, Bari, Italy

We report on the seismic response of slopes in the area of Qiaozhuang town (Qingchuan county), located 250 Km N-E of the epicenter of the 2008 Wenchuan earthquake (Sichuan Province). The earthquake caused significant damages on the slopes surrounding the town, including the Weigan hill, which was affected by diffuse opening of cracks. This suggested the possible occurrence of topographic amplification phenomena and motivated a subsequent in situ accelerometer monitoring. Recording stations were emplaced at the top and the toe of the Weigan hill, as well as at other sites located on slopes in the N-E periphery of the town. About 100 aftershocks of the Wenchuan sequence were recorded, whose magnitude varied between 1.2 ~ 5.5 and epicentral distance from a few to 103 km. A preliminary analysis of the the Weigan hill recordings provided evidence of the presence of directional variation of ground vibration possibly related to directional resonance. This phenomenon was first investigated by analyzing polar diagrams of normalized Arias intensity (I_a) and horizontal to vertical spectral ratio (HVSR) to find, respectively, polarization azimuth and resonance frequencies. The most pronounced I_a directivity was observed at a site near the hilltop, where ground motion maxima were found persistently orientated around N-S direction. Furthermore evidence of significant amplification was derived from HVSR data and from the comparison to other accelerometer monitoring points. Then, we conducted ambient noise measurements aimed at examining the azimuthal variation of the horizontal to vertical spectral ratios of noise recordings (HVNR) at the accelerometer station sites. This provided the possibility to test the reliability of site response directivity assessment inferred from ambient noise analysis. Noise measurements were carried out with two tromographs, using one of them as a continuously recording reference, while the second tromograph was moved through other sites for recording sessions of 46 minutes. The analysis of data showed the ubiquitous presence of a strong E-W oriented peak at low frequencies (below 1 Hz), likely related to the influence of a remote source of noise, as well as the presence of locally varying peaks. In particular, a preferential orientation of maximum ground vibration in N-S direction was found at the site near the Weigan hilltop, even though the spectral ratio amplitudes were not very high. This suggests the need of more advanced analysis to filter disturbing signals. In summary, the indications of directivity phenomena obtained through ambient noise data analysis were generally consistent with the findings based on the accelerometer data.