Geophysical Research Abstracts, Vol. 7, 06358, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06358

The Site and Path Effects in Ground Motion Variability: An Application of the Variance-Components Technique

Chu-Chuan Peter Tsai (1), Yi-Hau Chen (2), and Chia-Hsin Liu (1)

(1) Institute of Earth Sciences, Academia Sinica, 128 Sec. 2 Academia Road, Nankang, Taipei, Taiwan 115 (ctsai@earth.sinica.edu.tw / Phone: +886-2-2783-9910 x 316), (2) Institute of Statistical Science, Academia Sinica, 128 Sec. 2 Academia Road, Nankang, Taipei, Taiwan 115 (yhchen@stat.sinica.edu.tw / Phone: +886-2-2783-5611 x 303)

Since the 1999 Chi-Chi earthquake, the strong-motion recordings in Taiwan have increased tremendously. This offers an opportunity to explore the variability of ground motion estimates in Taiwan and to check the validity of the *ergodic* assumption commonly adopted in the standard probabilistic seismic hazard analysis. Chen and Tsai (2002) proposed the variance-components technique to decompose the prediction error of ground motions into three components: the earthquake-to-earthquake, the site-to-site, and the residual. The total variance of the prediction error could accordingly be divided into the corresponding three components. From a data set of over seven thousand records with various site conditions, we find that the relative percentages of the three components of variances are dependent on the numbers of earthquake events and stations in the sampled records, and the variances of the earthquake and the site components are in general smaller than that of the residual. It is apparent that the path-to-path component of error in ground motions is embedded in the residual. The Chen and Tsai's procedure cannot, however, resolve an additional component of the path error from the residual. We show here that if the variability of the path effect is empirically known *a priori*, the path-to-path component of error can be further split off from the residual. From the data set in this study, it is plausible to assume that the variability of the path component is comparable to that of the earthquake and the site. The uncertainty of prediction error reduces dramatically after ground motion estimates have been corrected considering the site and path effects of variability in ground motions. Nevertheless, in contrast to the site effect, the path component of error cannot

be directly eliminated from the ground motion estimates for future earthquake events. One possible way to take into account the path effect is to turn it into useful information like the 3D velocity structural model obtained from the inversion. If a 3D model describing the path effect for each source-to-site pair can be constructed, the reduction in ground motion variability accounting for both the site and the path effects may be feasible. This has significant implications for probabilistic seismic hazard analysis.