Using Aftershock data when Deriving Earthquake Ground-motion Prediction Equations

J. Douglas*
BRGM, Orléans, France.

B. Halldórsson
Earthquake Engineering Research Centre, University of Iceland, Austurvegur 2a, 800 Selfoss, Iceland.

Strong-motion databanks contain a large and growing proportion of records from aftershocks. Therefore, for the derivation of ground-motion prediction equations (GMPEs) aftershock recordings are a potentially important resource, especially in regions of low to moderate seismicity. Some authors have decided not to use strong-motion data from aftershocks to derive their GMPEs due to concerns over the spectral scaling of aftershock motions or they have included additional terms to model the difference in ground motions between aftershocks and mainshocks [1]. For areas with limited observational datasets these two approaches are unattractive since they oblige the deletion of a large proportion of already limited datasets or they require that additional coefficients be estimated based on few data points. In this study we use data from Europe, the Mediterranean area and the Middle East (EMME) and various statistical techniques to examine the potential issues with using aftershock data when deriving GMPEs. In addition, we examine data from a small-aperture strong-motion array recently installed in Iceland, ICEARRAY [2], to examine the scaling of aftershock ground motions and their variabilities with respect to magnitude and distance.

We find that aftershock ground motions in EMME are only slightly lower than mainshock motions and that ground-motion variabilities in these two datasets are similar. This suggests that the current general practice of not considering aftershock and mainshock data differently when deriving GMPEs can be maintained. In contrast to a number of recent studies, ICEARRAY ground-motion variability does not show a dependence on magnitude, suggesting that previously observed dependencies could be due to uncertain earthquake locations. In addition, these data show that inter-site variability for PGA, even over ~1.9 km, can be considerable, which suggests a lower bound on the standard deviations associated with GMPEs that is attainable is about 0.15.

References

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[2] Halldorsson, B., R. Sigbjornsson and J. Schweitzer (2009). ICEARRAY: the first small-aperture, strong-motion array in Iceland. *Journal of Seismology*, **13**(1), 173–178

*e-mail: J.Douglas@brgm.fr. url: www.eerc.hi.is, www.hi.is/ICEARRAY