A Variance-Weighted Approach to Site Response Mapping

THOMPSON, E. M., Tufts University, Medford, MA, eric.thompson@tufts.edu
BAISE, L. G., Tufts University, Medford, MA, laurie.baise@tufts.edu
KAYEN, R. E., United States Geological Survey, Menlo Park, CA, rkayen@usgs.gov
MORGAN, E. C., Tufts University, Medford, MA, eugene.morgan@tufts.edu
KAKLAMANOS, J., Tufts University, Medford, MA, james.kaklamanos@tufts.edu

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ABSTRACT:

The scale of previously proposed methods for mapping site response ranges from global coverage down to individual urban regions. Typically, spatial coverage and accuracy are inversely related. We use the densely spaced recorded strong motions in Parkfield, California, to estimate the accuracy of different site response mapping methods and demonstrate a method for integrating multiple site response estimates. Individual site response estimates are derived both from local and regionally available data. The local site response models include those based on velocity profiles using both V_{s30} (30 m divided by the S wave travel time to 30 m depth) and the square-root-of-impedence method and predominant site period estimated from recorded ground motions. The regional site response models include topographic slope and surficial geology based site response correlations. The proposed variance-weighted approach to site response mapping is the weighted mean of the suite of these different estimates, where the weights are the inverse of the variance of the individual estimates. Thus, the dominant site response model varies in space as a function of the accuracy of the individual models. For mapping applications, site response models should be judged in terms of both spatial coverage and the degree of correlation with observed amplifications. Performance varies with period, but in general the Parkfield data show that: (1) where a velocity profile is available, the square-root-of-impedance method outperforms the measured V_{s30}, and (2) where velocity profiles are unavailable, the topographic slope method outperforms surficial geology for short periods, but geology outperforms slope at longer periods.