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Regression Analysis of MCS Intensity and ground motion spectral accelerations, SA, in Italy

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We present the results of the regression analyses between Mercalli-Cancani-Sieberg, MCS, intensity and the spectral acceleration, SA, at 0.3s, 1.0s and 2.0s (SA03, SA10, SA20). In Italy, the MCS scale is used to describe the level of ground shaking suffered by manufactures or perceived by the people, and it differs to some extent from the Mercalli Modified scale in use in other countries. We have assembled a new SA/MCS-intensity data set from the DBMI04 intensity database and the ITACA accelerometric data bank. The SA peak values are calculated in two ways — using the maximum among the two horizontal components, and using the geometrical mean among the two horizontal components. The regression analysis has been performed separately for the two kinds of data sets and for the three target periods. Since both peak ground parameters and intensities suffer of consistent uncertainties, we have used the orthogonal distance regression technique. Also, tests designed to assess the robustness of the estimated coefficients have shown that single-line parameterizations for the regressions are sufficient to model the data within the model uncertainties.

For the maximum horizontal component, SAxx^{hm}, the new relations are

$$I_{MCS} = 1.24 \pm 0.33 + 2.47 \pm 0.18 \log SA0.3s^{hm}, \quad \sigma = 0.53,$$

$$I_{MCS} = 3.12 \pm 0.16 + 2.05 \pm 0.11 \log SA1.0s^{hm}, \quad \sigma = 0.36,$$

$$I_{MCS} = 4.31 \pm 0.10 + 2.00 \pm 0.10 \log SA2.0s^{hm}, \quad \sigma = 0.29.$$

For the geometrical mean SA, SAxx^{gm}, the new relations are

$$I_{MCS} = 1.40 \pm 0.31 + 2.46 \pm 0.18 \log SA0.3s^{gm}, \quad \sigma = 0.53,$$

$$I_{MCS} = 3.25 \pm 0.16 + 2.08 \pm 0.12 \log SA1.0s^{gm}, \quad \sigma = 0.38,$$

$$I_{MCS} = 4.46 \pm 0.10 + 2.01 \pm 0.10 \log SA2.0s^{gm}, \quad \sigma = 0.30.$$

Adoption of the geometric mean of the horizontal components, rather than the maximum value, results in a minor shift toward larger values of intensity for the same level of ground motion; this difference, however, is contained within the regression standard errors of the former. Comparisons carried out in various manners for earthquakes where both kinds of data (macroseismic and instrumental data) are available have shown the general effectiveness of the relations.