REGRESSION ANALYSIS OF PEAK LEVELS OF EARTHQUAKE STRONG GROUND MOTION: A COMPUTATIONAL STUDY

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The need for a method of estimating the values of strong ground motion in the central United States due to earthquakes of given sizes is real. This problem is compounded by a lack of strong motion data upon which to make decisions.

In an attempt to gain some understanding of the behavior of ground motion in this region, a theoretical analysis of strong ground motion was undertaken. Complete synthetic time histories were computed for point dislocation sources embedded in a plane layered medium at a depth of 5 km. These computations were generated at distances of 5 to 500 km for different values of the duration of the source pulse for a constant seismic moment. Peak values of acceleration, velocity and displacement attained in this analysis are used in a regression analysis to test the validity of proposed scaling relations expressing peak ground motion in terms of seismic moment, corner frequency and geometrical spreading.

Source spectrum scaling concepts and studies of SH waves in the near-regional field have lead to the mathematical expressions of peak levels of strong ground motion in terms of seismic moment, M_o, corner

frequency, f_c, and geometrical spreading G(R), as

$$a_{max} = A\ M_o f_c^3 G(R)$$
$$v_{max} = B\ M_o f_c^2 G(R)$$
$$d_{max} = C\ M_o f_c\ G(R)$$

where a_{max}, v_{max} and d_{max} are the maximum acceleration, velocity and displacement, respectively. Based on observed relations between seismic moment and stress drop and a corresponding relationship with magnitude, these expressions may be expressed as

$$\log a_{max} = D + 0.5m_b - 1.0\log R$$
$$\log v_{max} = E + 1.0m_b = 1.0\log R$$
$$\log d_{max} = F + 1.5m_b = 1.0\log R$$

where R is distance in km.

The regression analyses done in this study indicate these expressions are valid for use in real earth modeling. Multiple correlation coefficients and F-statistics indicate the regression models fit the data well. Standard deviations of the logarithm of the ground motion parameter compare favorably to those determined in real earth studies.