A Comparison of M_L to m_{Lg} for Large California Earthquakes with Scaling Considerations for Strong Ground Motion

John Alexander Chulick, B.S.

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Earthquake magnitudes are simple and convenient for specifying earthquake source size. It is important to understand the relation of various magnitude scales to one another and, in addition, their relationship to strong ground motions. M_L and m_{Lg} are two scales sampling the frequency range of most interest to strong-motion prediction. This project is an evaluation of the relationship between the two magnitude scales.

The method of synthesizing Wood-Anderson seismograms from accelerograph records, developed by Kanamori and Jennings (1978), is extended to short-period WWSSN seismograms. These synthesized records are the basis for studying the relation between M_L and m_{Lg} for large California earthquakes.

A linear relationship was found between the two scales

$$m_{Lg} = (0.82 \pm 0.02) M_L + (0.85 \pm 0.10)$$

where the errors are the 95% confidence levels. This relation does not have the slope of 1.0 observed by Nuttli and Herrmann (1982). The difference probably occurs because the various frequencies that comprise the earthquake signal are not evenly distributed and that the instruments do not sample identical frequency bands. m_{Lg} values are given for several events with multiple station recording. m_{Lg} for the 1952 Kern County earthquake is 6.8, for the 1957 San Francisco earthquake is 5.3, for the 1966 Parkfield earthquake is 6.0, for the 1968 Borrego Mountain earthquake is 6.6, and for the 1971 San Fernando earthquake is 6.2.

Strong-motion attenuation relations developed by Joyner and Boore

(1981) for California are modified for use with m_{Lg}. Random vibration modeling is applied to several events in an attempt to extract more information on the relationship between the magnitude scales and strong-motion parameters. A problem with this technique is that it requires detailed knowledge of the Q structure of the crust in the region under study.