The Relation between $m_{bLg}$ and $M_w$ and between $m_{Lg}(f)$ and $M_w$ Using Recent US Earthquakes and Random Vibration Theory

C. Rigsby, Saint Louis University, crigsby@slu.edu; R. B. Herrmann, Saint Louis University, rbh@eas.slu.edu

---

**Background**

- The $Lg$ phase is a superposition of higher-mode surface waves with a group velocity between 3.2 and 3.5 s and with a period between 0.7 and 1.3 s.
- Nuttli (1973) developed the $m_{bLg}$ magnitude scale to quantify the size of an earthquake from 1-second-period $Lg$ waves on WWSSN short-period vertical seismograms.
- Nuttli (1986) reformulated the original $m_L$ formula in terms of ground motion at 10 km and accounted for different coefficients of anelastic attenuation.
- Herrmann and Kijko (1983) modified the $m_{bLg}$ scale to account for the frequency of the observed $Lg$ waves. In this study, 2 methods are employed for each calculation of $m_{bLg}$ and $m_{Lg}(f)$. The poster presents only the SLU Method, the method that attempts to replicate the USGS procedure for calculating $m_{bLg}$.

**Objectives**

- Derive relationship between $m_{bLg}$ and $M_w$ from earthquake data and RVFT
- Derive relationship between $m_{Lg}(f)$ and $M_w$ from earthquake data and RVFT
- Address whether a single $y$ is appropriate for the central and eastern United States

**Methods**

- Processing procedure for SLU computation of $m_{bLg}$
- The regression analysis uses linear least squares regression for Figure A
- Figure A depicts the relationship between the published $M_{bLg}$ magnitudes and the $Lg$ $m_{bLg}$ magnitudes
- Figure B depicts the relationship between the SLU $M_{bLg}$ magnitudes and the $SLU m_{bLg}$ magnitudes
- Figure C depicts the relationship between the SLU $P_{Lg}$ magnitudes and the $SLU M_{Lg}$ magnitudes
- Figures A-C: the red line is the regression line, the blue line is the best confidence band on the regression line, and the blue dotted lines are the 95% confidence bands on the lines.

**Conclusions**

- The regression analysis and modeling support a linear relationship between $m_{bLg}$ and $M_w$ and between $m_{Lg}(f)$ and $M_w$ for $3.0 < M < 4.2 $
- The lack of data for larger events prevents confident predictions for larger $m_{bLg}$ or $m_{Lg}(f)$
- We have confidence in using $m_{bLg}$ and $m_{Lg}(f)$ to estimate $M_w$ for smaller events
- A single $y$ is probably not appropriate for the central and eastern United States.