

*Joyner-Boore functional form*

$$\log A = \alpha + \beta M - \log \sqrt{d^2 + \delta^2} - \gamma \sqrt{d^2 + \delta^2}$$

Random effects for earthquake

Borrowing strength

$$\log A_{ij} = \alpha_i + \beta_i M_i - \log(\sqrt{d_{ij}^2 + \delta_i^2}) - \gamma_i \sqrt{d_{ij}^2 + \delta_i^2} + \varepsilon_{ij}$$

where  $\alpha_i, \beta_i, \gamma_i, \delta_i, i=1, \dots, I$  are independent realizations of random variables