Empirical Modeling of Basin Effects: The Case of CB14

CoreLogic®

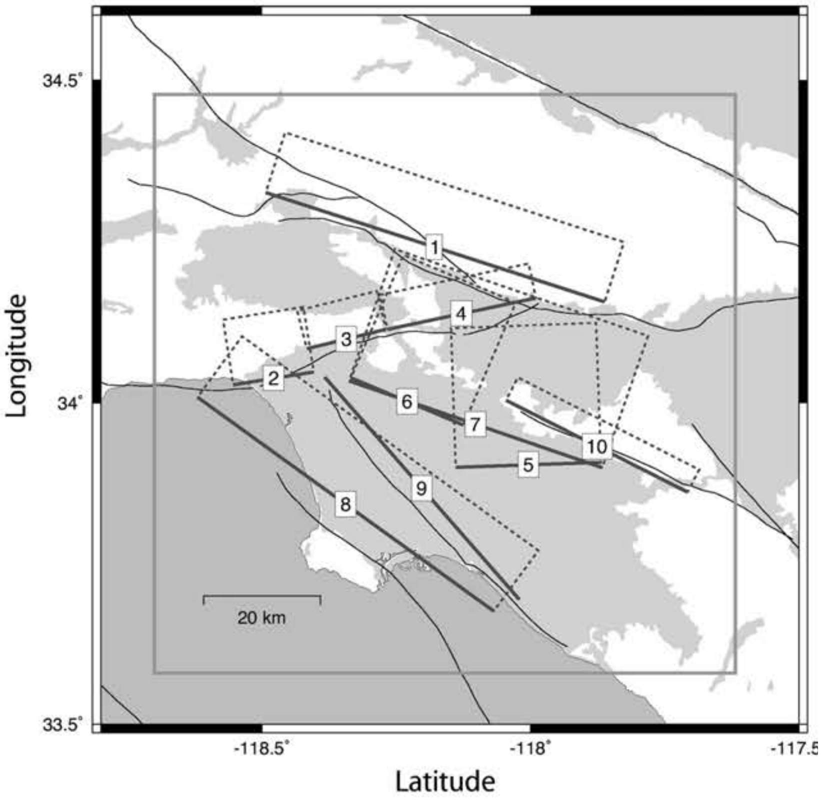
Numerical 3-D Ground Motion Simulations of Basin Effects by Day et al. (2008)

Simulation Approach

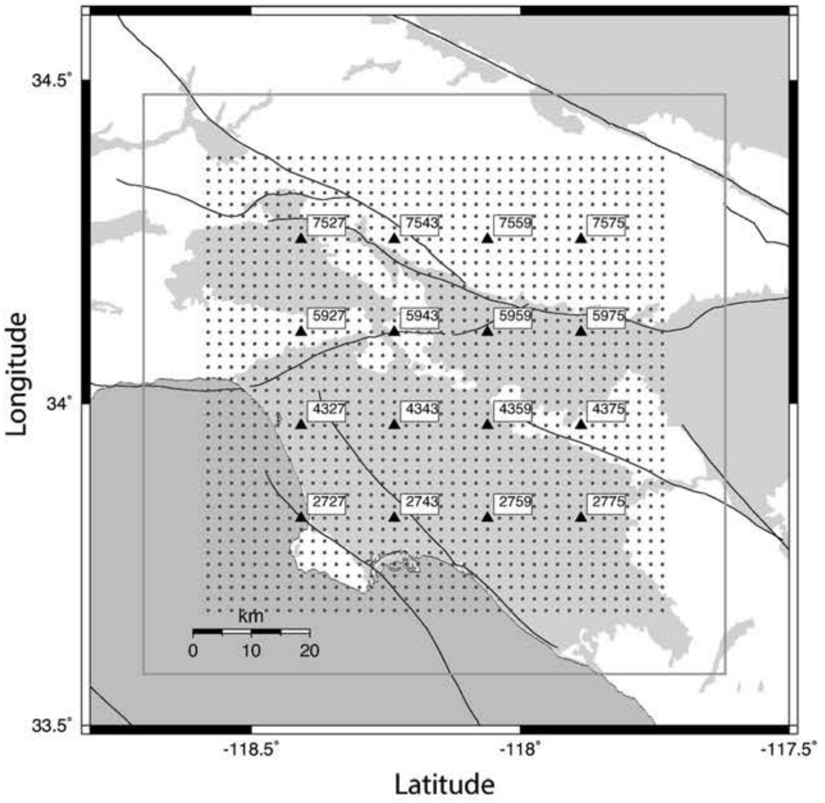
- 3-D numerical ground motion simulations in Los Angeles area
- 3-component synthetics at 1600 sites
- Long period response spectra at 26 periods (2–10 sec)
- 60 regional earthquake scenarios (**M** 6.3–7.1)
- Basins defined using SCEC Community Velocity Model (CVM)
- Three basin depths considered for parametrization:
  - Depth to 1.0 km/sec shear-wave velocity horizon ($Z_{1.0}$)
  - Depth to 1.5 km/sec shear-wave velocity horizon ($Z_{1.5}$)
  - Depth to 2.5 km/sec shear-wave velocity horizon ($Z_{2.5}$)
- Developed equations relating basin amplification to basin depths:
  - Includes both 1-D and 3-D response
  - Relative to 1-D response of 3.2 km/sec reference rock

Ground Motion Simulations

Modeled Events

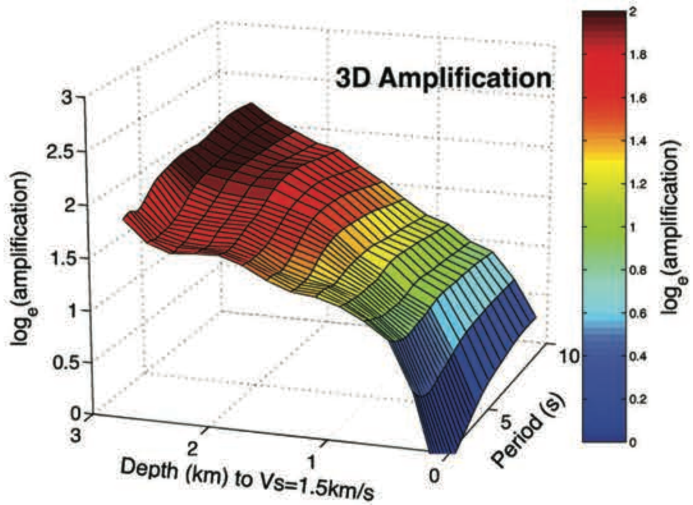


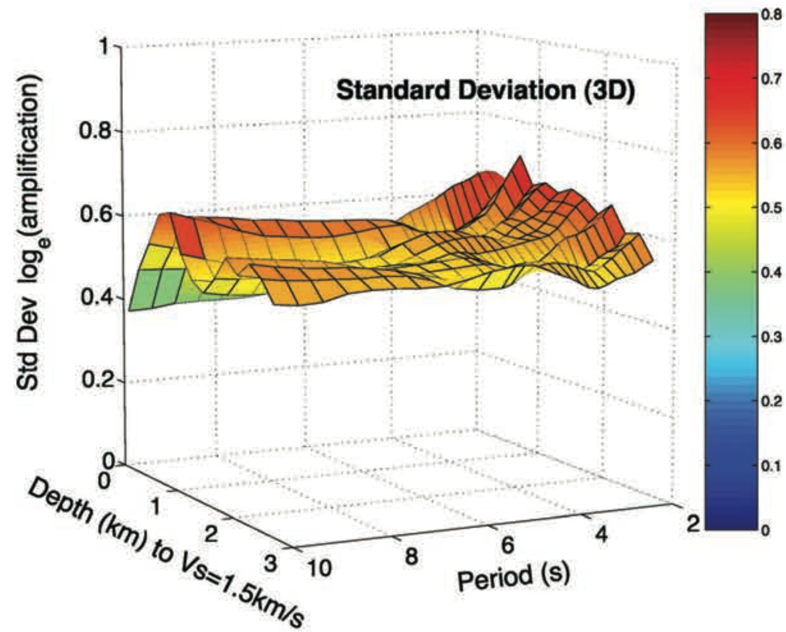
Simulation Grid

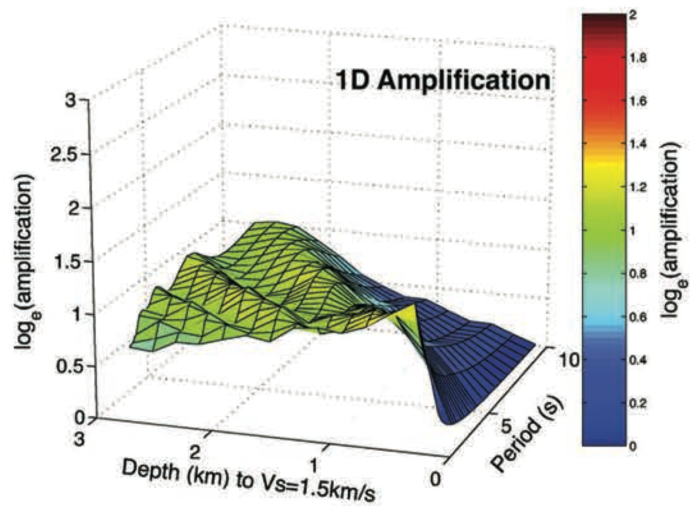


CoreLogic®

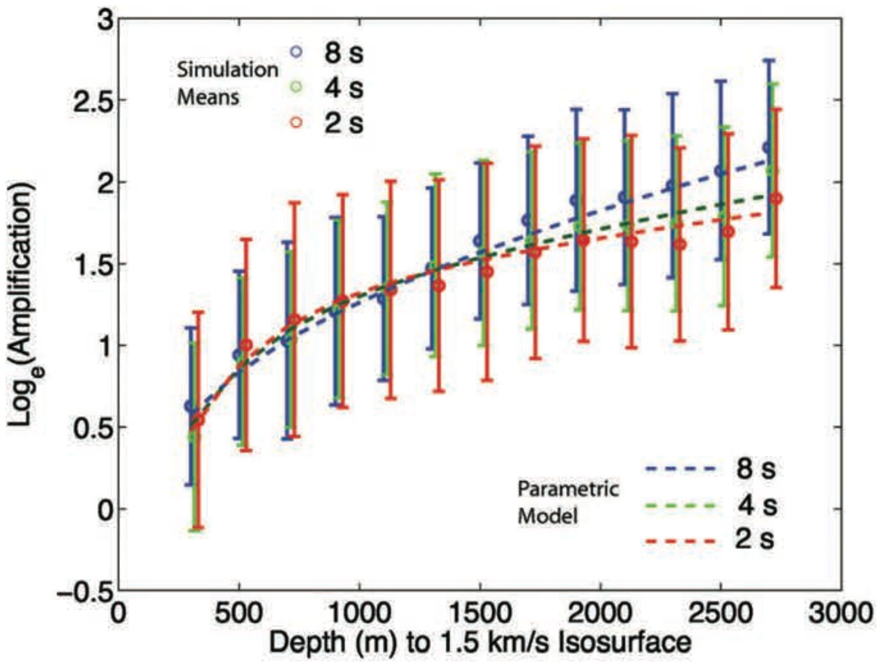
Spectral Response Amplification

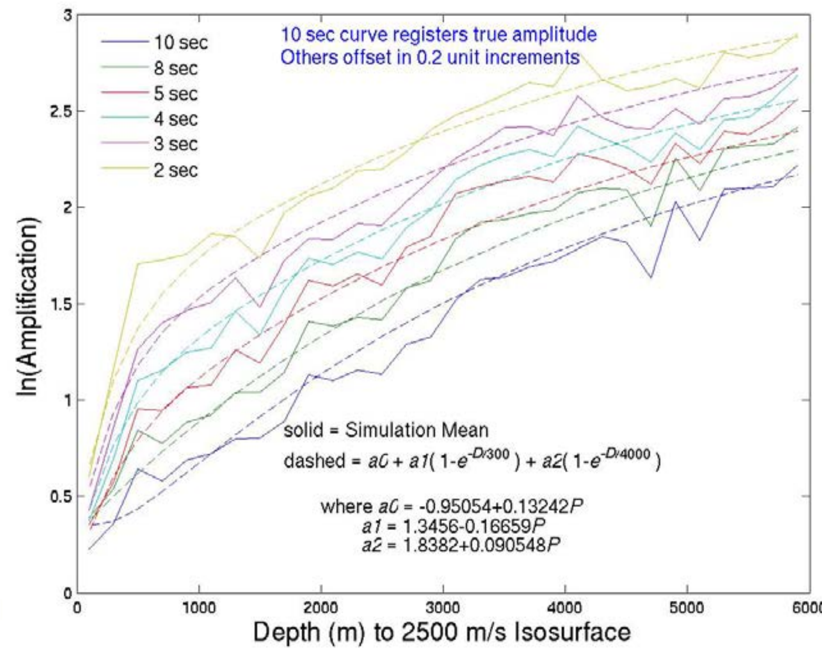






Parameterized Amplification Model





Empirical Model by Campbell and Bozorgnia (2014)

Empirical Approach

- Develop GMPE with V_{S30} term but with no basin effects
- Compile values of $Z_{2.5}$ for as many recording sites as possible:
  - SCEC CVM for Southern California
  - USGS CVM for San Francisco Bay Area
- Plot residuals vs. basin depth for all periods (0.01–10 sec)
  - Found no residual trend between $Z_{2.5}$ = 1–3 km (base case)
  - Found increasing residuals between $Z_{2.5}$ = 3–7 km
  - Found decreasing residuals between $Z_{2.5}$ = 0–1 km
- Fit deep trend by calibrating functional form of Day et al. (2008)
- Fit shallow trend empirically using residuals
- When basin depth is not known recommend estimating it from V_{S30}

Parameterized Amplification Model