LESSONS LEARNED ON GROUND MOTIONS FROM LARGE INTERFACE SUBDUCTION ZONE EARTHQUAKES FROM 2010 M 8.8 MAULE, CHILE AND 2011 M9.0 TOHOKU, JAPAN EVENTS

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Extended Abstract

In this presentation, I will review the results of analyses of ground motions recorded during the large interface subduction zone earthquakes in Maule Chile (**M** 8.8, 2010) and Tohoku Japan (**M** 9.0, 2011). I will also describe how these analyses influenced the selection of ground motion prediction equations (GMPEs) for subduction zone regions in the Global Earthquake Model (GEM) project organized through the Pacific Earthquake Engineering Research Center (PEER). The work discussed in this presentation is largely presented in prior publications by Boroschek et al. (2012), Stewart et al. (2013a), and Stewart et al. (2013b).

The **M** 8.8 Maule Chile earthquake produced 31 usable strong motion records over a rupture distance range of 30 to 700 km. Site conditions range from firm rock to soft soil but are most often competent soil (NEHRP Category C or C/D). Most of the data were recorded on analogue instruments, which was digitized and processed with low- and high-cut filters designed to maximize the usable frequency range of the signals. The stations closest to the fault plane do not exhibit evidence of ground motion polarization from rupture directivity. Response spectra of nearby recordings on firm ground and soft soil indicate pronounced site effects, including several cases of resonance at site periods. The Atkinson and Boore (2003) GMPE for interface subduction events captures well the distance scaling and dispersion of the data, but under-predicts the overall ground motion level, perhaps due to too-weak magnitude scaling.

The **M** 9.0 Tohoku-oki Japan earthquake produced approximately 2000 ground motion recordings. Stewart et al. (2013a) considered 1238 three-component accelerograms corrected with component-specific low-cut filters. The recordings have rupture distances between 44 and 1000 km, time-averaged shear wave velocities of $V_{s30} = 90$ to 1900 m/s, and usable response spectral periods of 0.01 to >10 sec. The Tohoku and Maule data support the notion that the increase of ground motions with magnitude saturates at large magnitudes. High frequency ground motions demonstrate faster attenuation with distance in backarc than in forearc regions, which is only captured by one of the four considered ground motion prediction equations for subduction earthquakes (Abrahamson et al., 201s). Event terms evaluated from recordings within 100 km of the fault are generally positive (indicating model under-prediction) at short periods and zero or negative (over-prediction) at long periods. Site amplification scales minimally with V_{s30} at high frequencies, in contrast with other active tectonic regions, but scales strongly with V_{s30} at low frequencies.

The features of the ground motion trends with magnitude and distance observed from the Maule Chile and Tohoku Japan events had a substantial impact on the selection of GMPEs for subduction zones in the GEM-PEER project. I will describe the GMPE selection procedure developed in that project. I will also indicate the GMPEs that were selected and the rationale for doing so.

References

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