Near source ground-motion modelling of the Canterbury aftershocks and implications for engineering systems

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The 2010-2011 Canterbury earthquake sequence includes the 22 February 2011 Christchurch aftershock (Mw 6.2), the June 2011 Mw 6.0 aftershock, the December 2011 magnitude (Ml) 5.8 and 6.0 aftershocks and the February 2016 Mw5.7 Valentine's day earthquake. These events caused widespread liquefaction, rockfalls and heavy building damage and collapse.

Holden and Kaiser (2016) compute broadband synthetic seismograms for the largest M5.7+ aftershocks of the 2010-2011 Canterbury earthquake sequence at near-source sites. They employ a stochastic approach to compute the seismograms that is not only controlled by detailed source models but also by regional parameters derived using spectral inversion of the extensive Canterbury strong motion dataset. Their results show that using appropriate stress drop value and site-specific amplification functions helps greatly to reproduce typical key engineering parameters such as peak ground accelerations (PGAs) and response spectra.

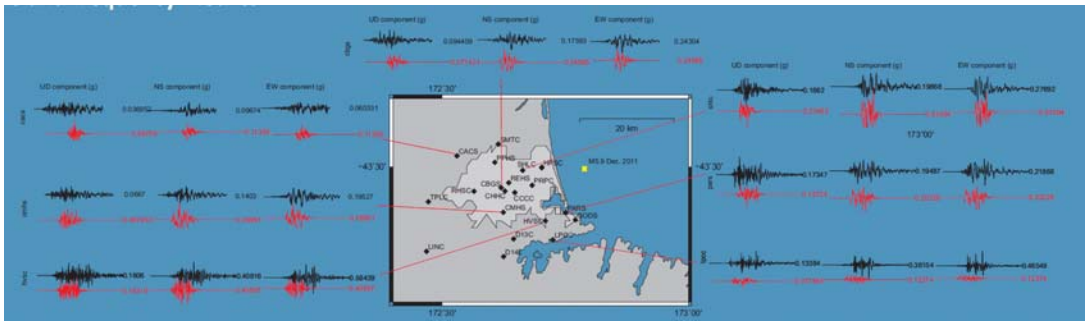

Figure 1: acceleration time histories (15 seconds) for vertical and horizontal components of GM at selected sites following the Mw5.9 December 23rd earthquake (RED Synthetic - BLACK Observed). Adapted from Holden and Kaiser, (2016).

We test the synthetic ground motion models of Holden and Kaiser (2016) against newly developed metrics by Rezaeian et al. (2015). These new metrics are ideally suited for the validation of ground motion models for structural and geotechnical engineering systems. Results from these tests are expected to bring valuable insights on characteristics of the Canterbury ground motions and on the modelling approach.

References

Holden, C.; Kaiser, A.E. 2016 Stochastic ground motion modelling of the largest Mw 5.9+ aftershocks of the Canterbury 2010–2011 earthquake sequence. New Zealand Journal of Geology and Geophysics, 59(1): 187-201; doi: 10.1080/00288306.2015.1133664

Rezaeian, S., Zhong, P., S. Hartzell, and F. Zareian (2015). "Validation of Simulated Earthquake Ground Motions based on Evolution of Intensity and Frequency Content," Bulletin of the Seismological Society ofAmerica (BSSA),Vol. 105, pp. 3036-3049, doi: 10.1785/0120140210