Seismic Hazard Analyses of Victoria, British Columbia, Canada: Considering an Active Leech River Fault

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1 - Introduction

The Leech River fault (LRF) is situated on Vancouver Island near the city of Victoria, British Columbia, Canada. Recent paleoseismic evidence suggests there to be at least 2 surface rupturing events which have exceeded a moment magnitude (M) of 6.5 within the last 15,000 years (Morel et al., 2017). We seek to understand the hazard implications of a significant rupture emanating from the LRF in Victoria and southern British Columbia.

Probabilistic Seismic Hazard Analyses are accomplished to replicate the 2015 National Building Code of Canada ground motions at a 2% probability of exceedance in 50 years to calibrate our simulations. Adding an active LRF fault with recurrence parameters from three different seismicity catalogs demonstrates significant increases in earthquake hazard for Victoria based on the applied Ground Motion Prediction Equations (GMPEs). Peak ground acceleration increased by 16% for GMPEs with a hypocentral distance metric or 114% for GMPEs with a projected fault plane distance metric.

Uncertainties in LRF earthquake ruptures including rupture area and geometry (magnitude), propagation velocity, and slip distribution will be captured within a suite of deterministic scenarios to assess impact of LRF earthquake ruptures to Greater Victoria. The suite of deterministic earthquake scenarios includes plausible slip models from empirical large earthquakes mapped onto the LRF.

2 - Probabilistic Seismic Hazard Analyses

Probability Seismic Hazard Analyses (PSHA) for Greater Victoria considering an active LRF: We develop a suite of earthquake slip (spatial distribution) models for future 3D wave propagation simulations using a finite-difference method (Olsen, 1994). The same earthquake rupture models will be used to predict broad-band waveforms in stochastic seismic source modeling.

3 - Deterministic Seismic Hazard Analyses

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3.1 Deterministic Seismic Hazard Analyses

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4 - Future Work

- Generate a suite of scenario M 6.7 earthquake rupture models by modifying empirical slip distribution models and applying hypocentral location (rupture initiation), rupture direction, etc.
- Implement suite of rupture models in DSHAs using low-frequency 3D finite-difference wave propagation simulations supplemented with broadband stochastic finite-fault simulations.

References


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