QuakeCoRE
NZ Centre for Earthquake Resilience

QuakeCoRE GMSV research coordination and current priorities

SCEC GMSV workshop 2016

Brendon Bradley

WEB: www.quakecore.nz
WIKI: https://wiki.canterbury.ac.nz/display/QuakeCore/

UC University of Canterbury · The University of Auckland New Zealand · Resilient Organisations · GNS Science · Massey University · Te Whare Wānanga o te Upoko o te Ika a Māui Victoria University of Wellington · The University of Waikato Te Whare Wānanga o Waikato · BRANZ

QuakeCoRE Flagship Programmes

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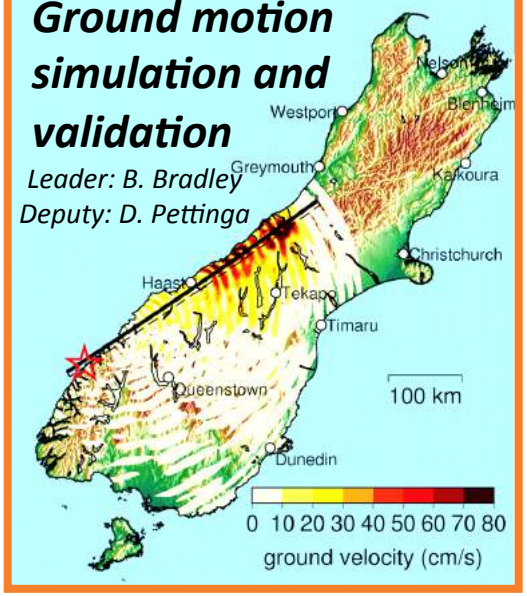
Ground motion simulation and validation

Leader: B. Bradley
Deputy: D. Pettinga

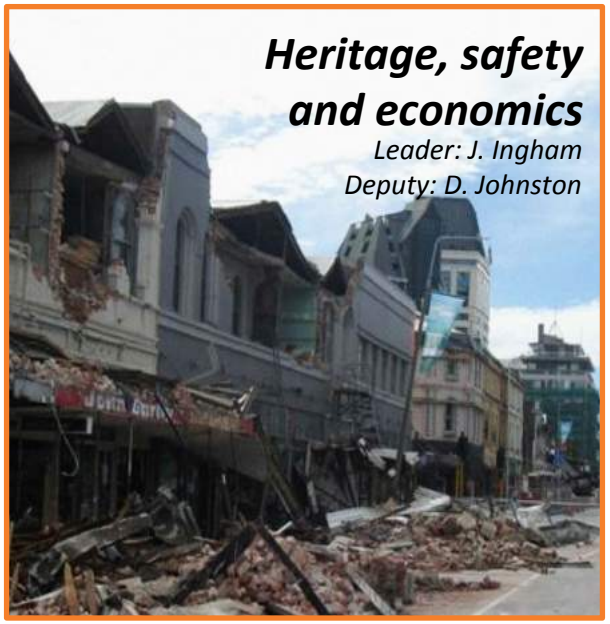


Liquefaction impacts on infrastructure

Leader: M. Cubrinovski
Deputy: S. van Ballegooy

Heritage, safety and economics

Leader: J. Ingham
Deputy: D. Johnston



Next-generation infrastructure

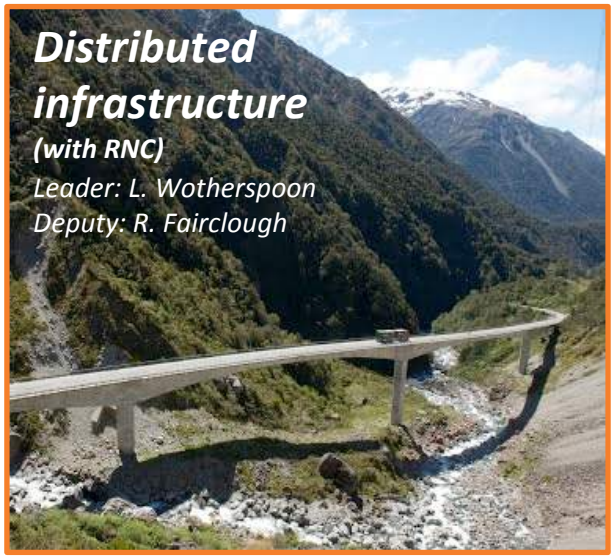
Co-Leader: K. Elwood
Co-Leader: S. Pampanin

Pathways to resilience

Leader: E. Seville
Deputy: T. Hutton

Distributed infrastructure

(with RNC)
Leader: L. Wotherspoon
Deputy: R. Fairclough



FP1: Spectrum of research

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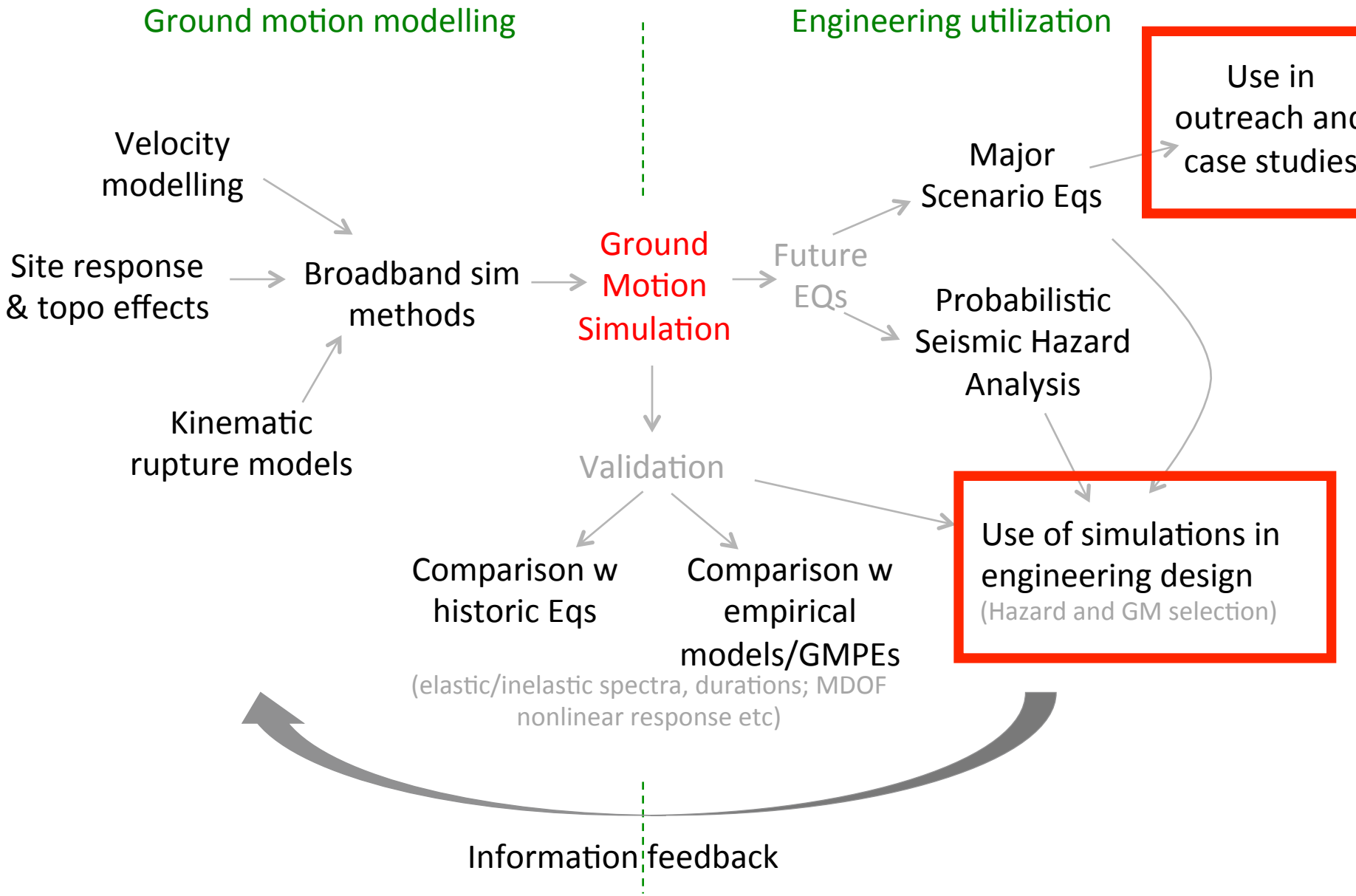

Thrust Areas and 2016 projects

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1. **Simulation methods:** Development/refinement of ground motion simulation methods that enable the generation of acceleration time series for the seismic response analysis of infrastructure (including kinematic 'rupture generators').

#16002(Somerville) Sim Validation of two historical NZ Subduction Eqs

2. **Velocity model development**: Development of ‘velocity models’ of the earth's crust in new regions of NZ, or improve those in existing regions; such models should provide resolution at the length scales necessary for broadband ground motion simulations

#16027(Wotherspoon) Site Characterization Nelson/Tasman Region

#16030(Bradley/Lee) 3D Tomography to improve Canterbury Vel Model

3. **Nonlinear site and topographic response:** Develop, validate, and apply models for nonlinear near-surface site and topographic response for use in conjunction with GM simulation methods.

#16030(Bradley/Jeong) Topographic simulation Port Hills, Christchurch

4. **Application for major NZ EQ scenarios:** Utilize ground motion simulations to forecast the severity of ground shaking over spatially-distributed regions in future major NZ earthquakes.

#FP1Postdoc(Nazer) Sim Porters Pass fault rupture

5. **Uncertainties and PSHA:** Examination of modelling uncertainties in ground motion simulation methods and utilization for probabilistic seismic hazard analysis

#16006(Stirling) Sim Validation Clyde fault using Fragile Geologic Features

#16030(Bradley/Razafindrakoto) Non-ergodic analysis Canterbury simulations

6. **Use of simulations in earthquake engineering analyses:** Explore the role of simulated ground motions for use in seismic response analysis of engineering infrastructure, including comparisons with as-recorded ground motions and development of procedures for simulated ground motions in infrastructure seismic design guidelines.

#16035(Pettinga) Guidelines for utilizations of GM sim in eng practice

#16057(Luco) Coordination of QuakeCoRE and SCEC GMSV efforts

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Ground motion sim validation

Razafindrakoto, Lee et al.

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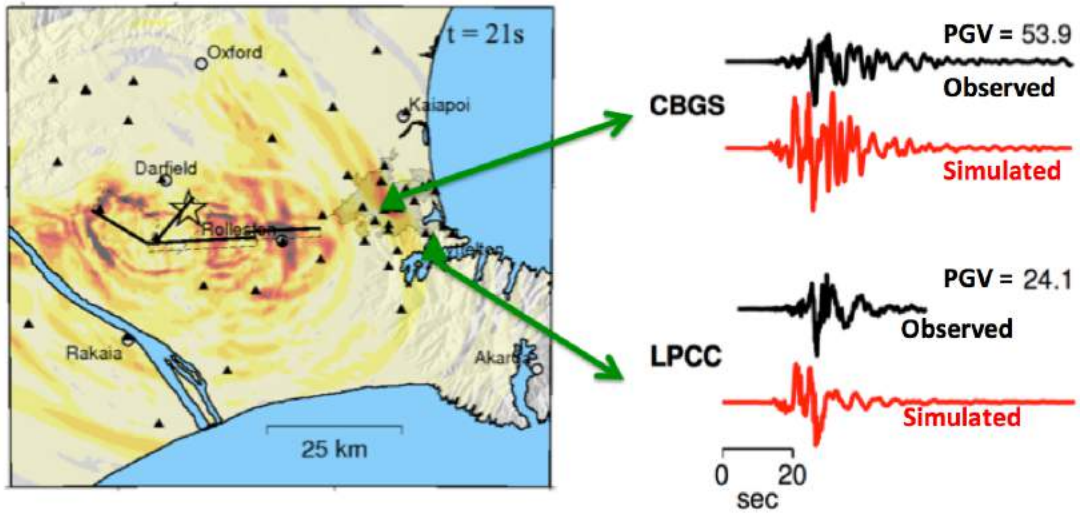
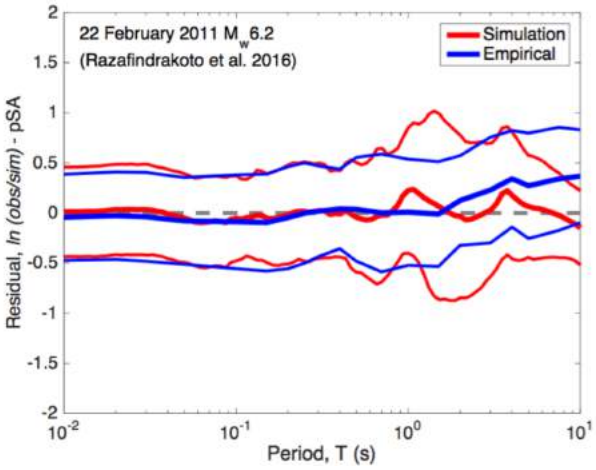
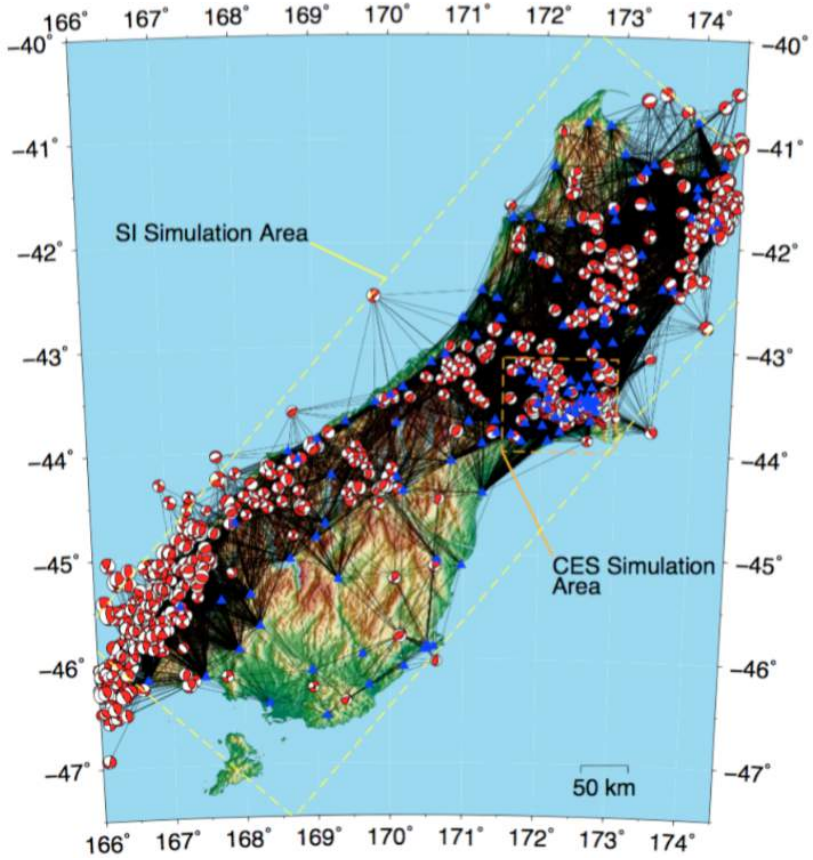
Validation against 10 major events in the Canterbury EQ Sequence





Result: *Simulations as good as empirical models at short periods, and better at long periods*

Validation against small-to-moderate (Mw3.0-4.5) EQs



Validation of Strong Ground Motion Simulations of two Historical NZ Subduction Zone Earthquakes on the SCEC BBP

Somerville et al.

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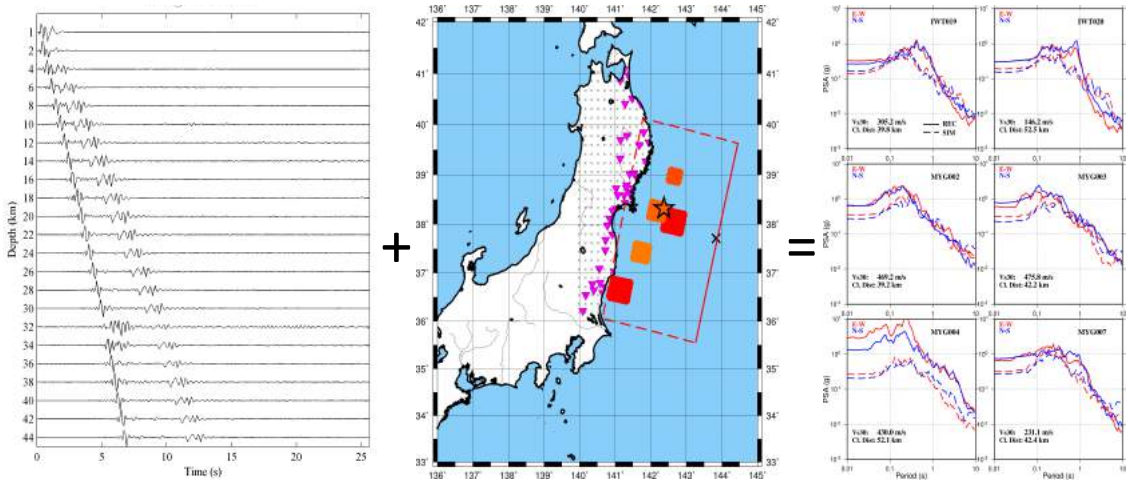
1. Simulation of the Tohoku M9.0 Event in BBP

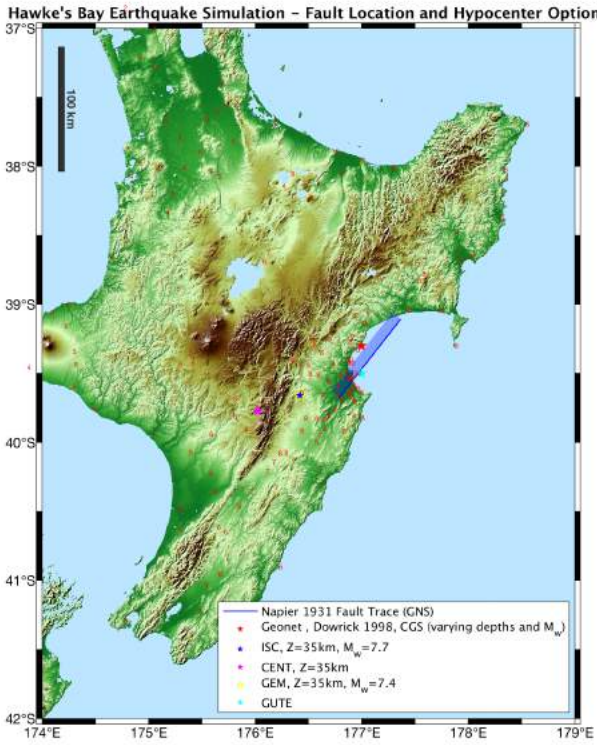


- *2. 1931 Napier: GNS fault geometry: imbricate reverse fault in accretionary prism, depth 20 km*
- *Use the Geonet hypocenter and magnitude*
- *Estimate MMI from simulations and compare with the observed values from Dowrick (1990)*

3. Pending

- ***Validate strong ground motion simulations for the 2009 Fiordland earthquake***

2. Validation of Strong Ground Motion Simulations of the Napier 1931 event



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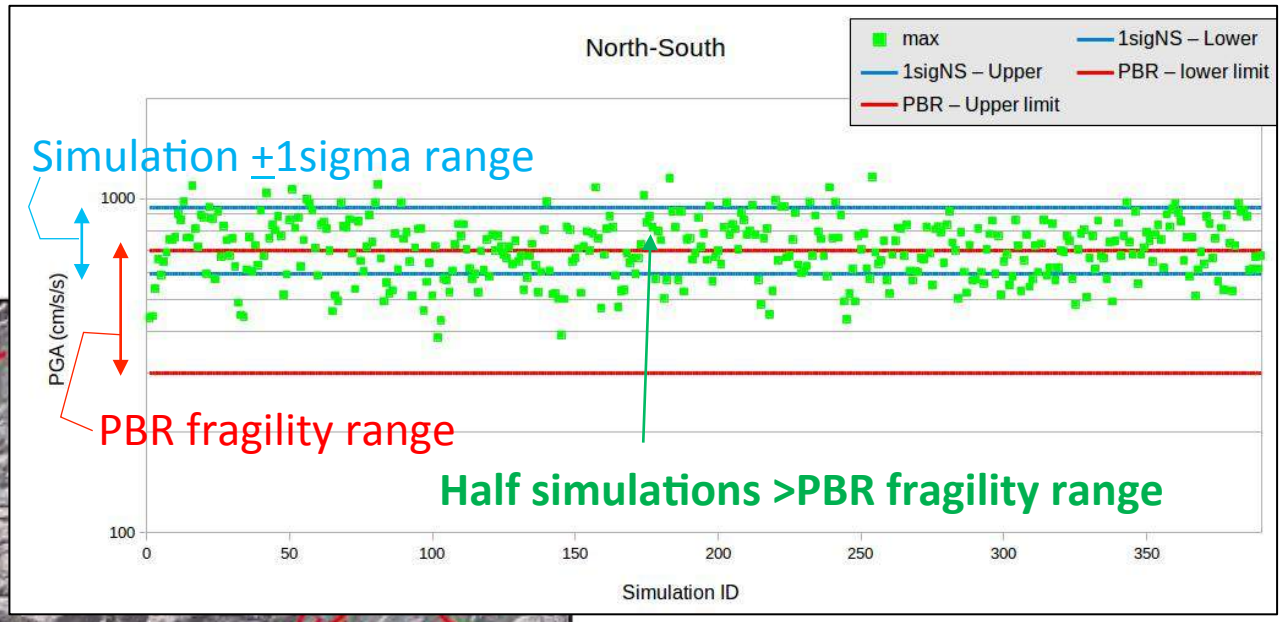
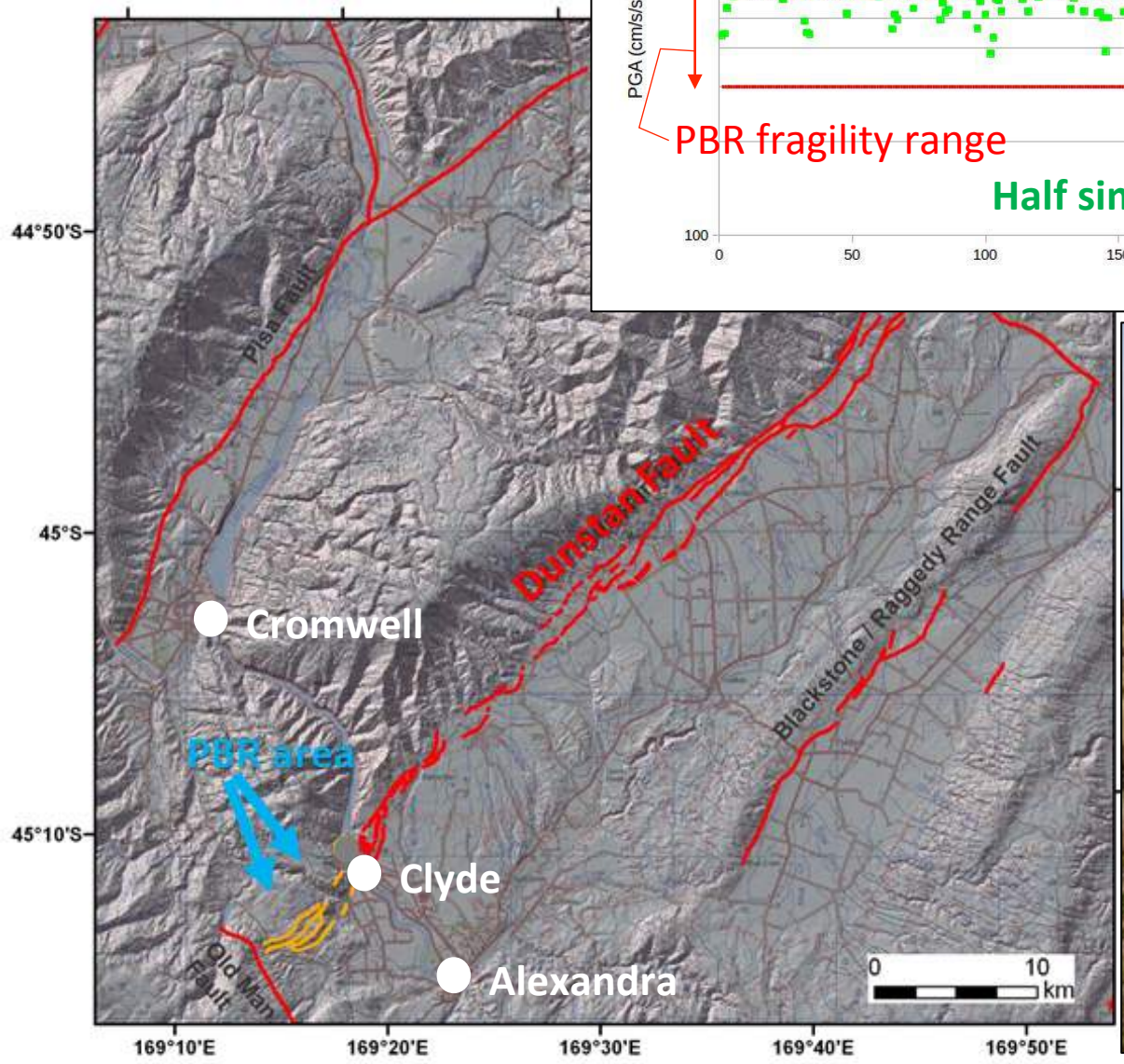
Validation of ground motion simulations using Precariously Balanced Rocks: *Bowie et al.*





A 3D seismic velocity model of Canterbury *Lee et al.*

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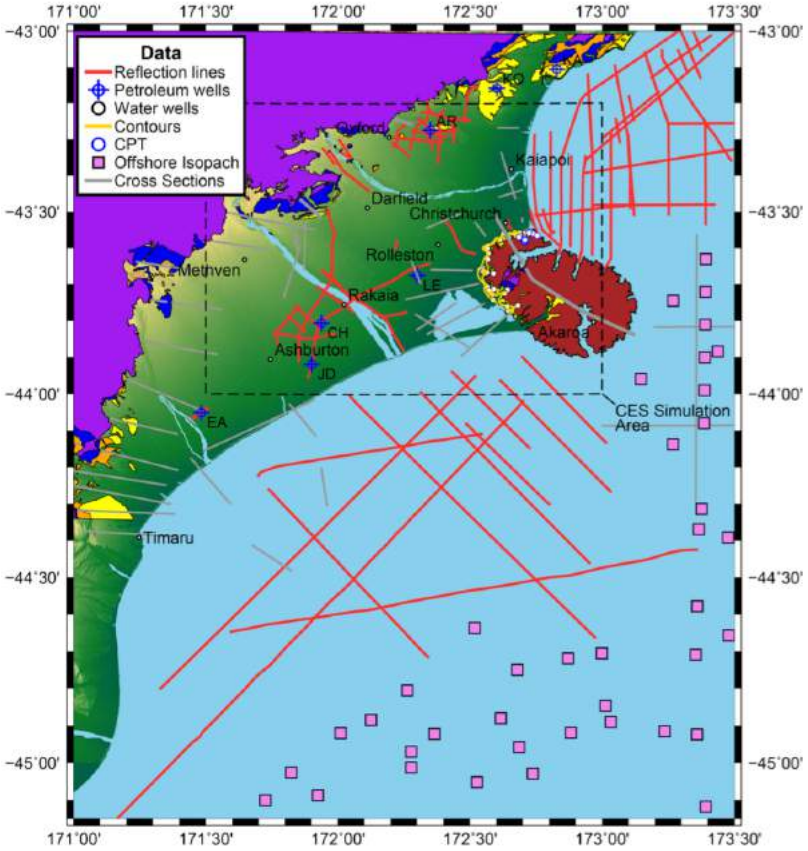
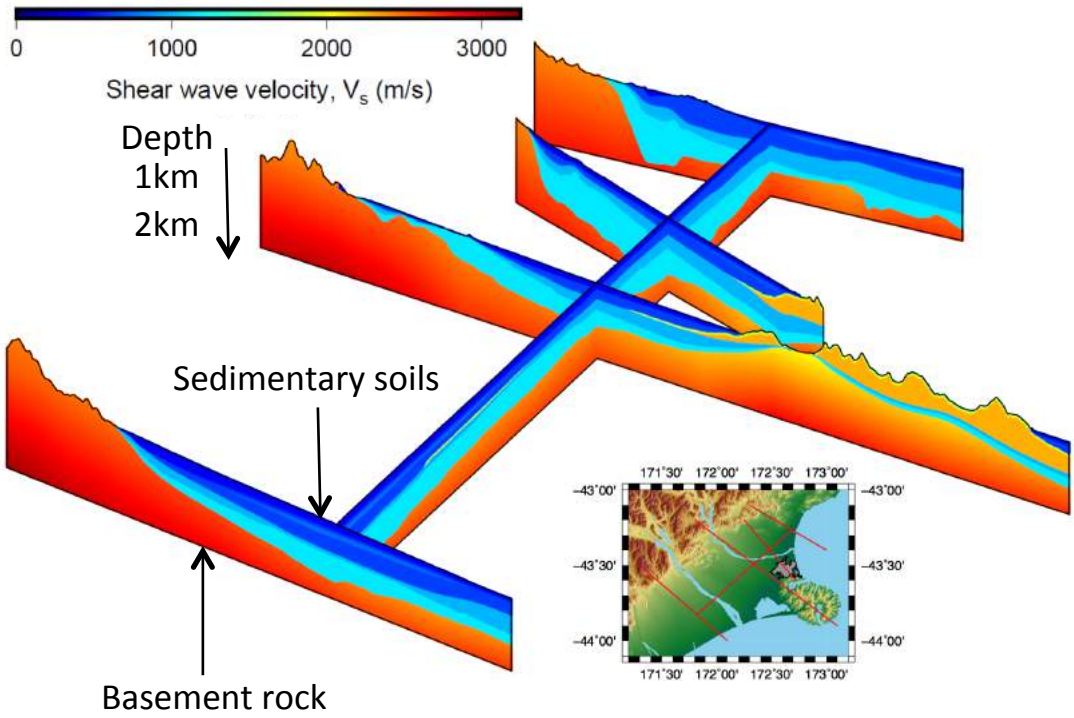
- First quantitative basin model of region integrating multi-disciplinary datasets
- Integral for accurate GM simulation at frequencies of engineering interest





Geotechnical & geophysical characterization of NZ Regions:

Wotherspoon et al.

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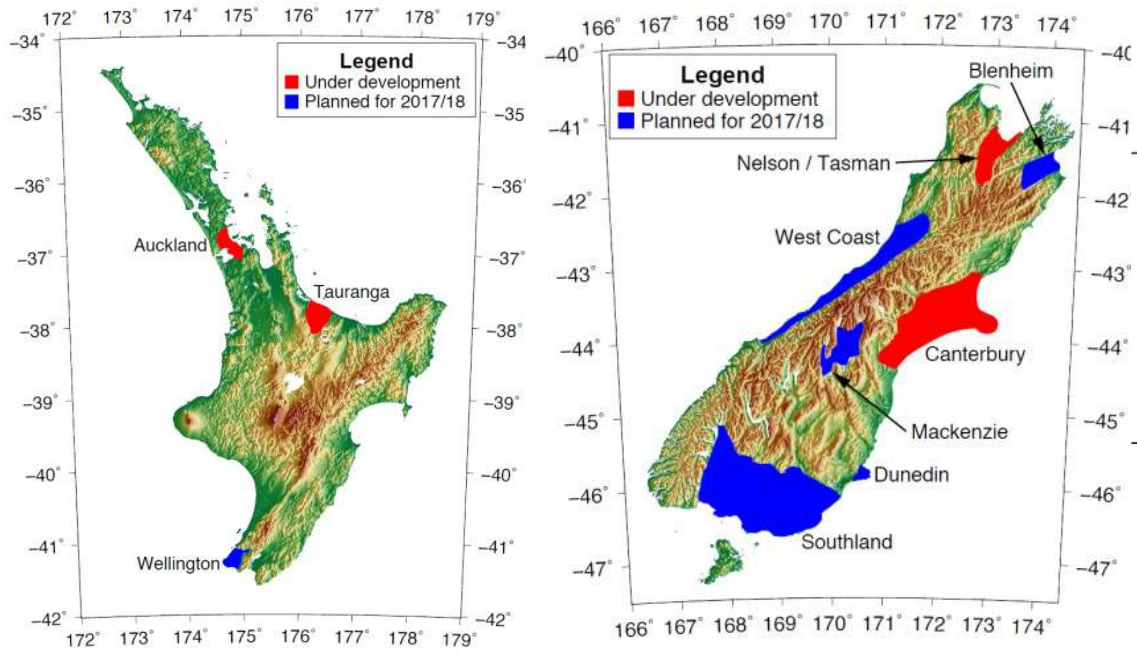
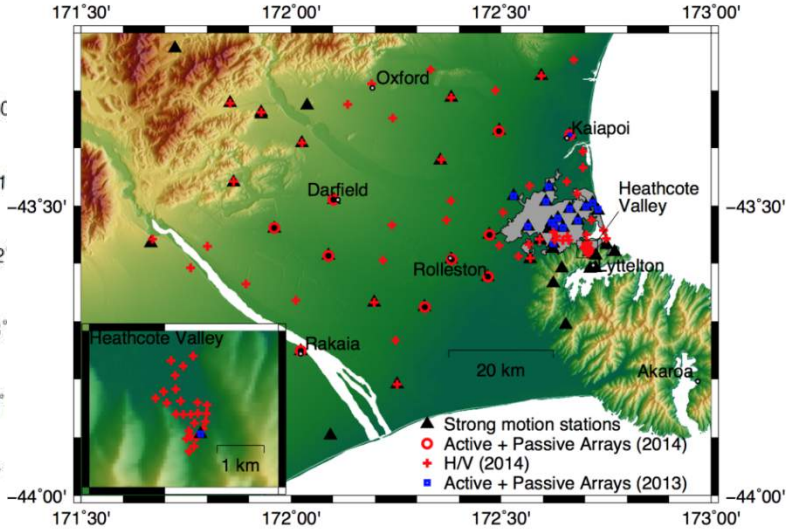
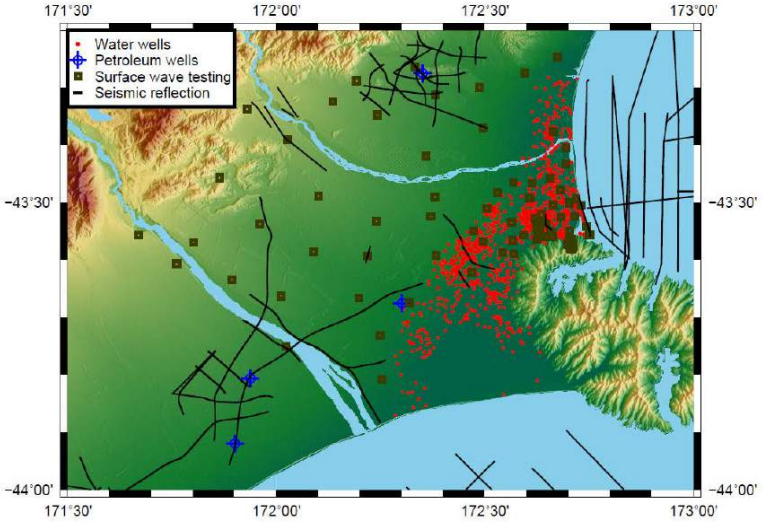


QuakeCoRE investigation regions





Canterbury Investigation Data

Canterbury: Detailed basin velocity model
Auckland: CBD waterfront T_0 model and material V_S
Tauranga: Initial basin T_0 characterisation and material V_S

Outputs feed into: Improved site subsoil classification, dynamic site metrics (e.g. T_0, V_{S30}), and velocity models for GM simulation

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Future large magnitude earthquakes

Nazer, Bae et al.

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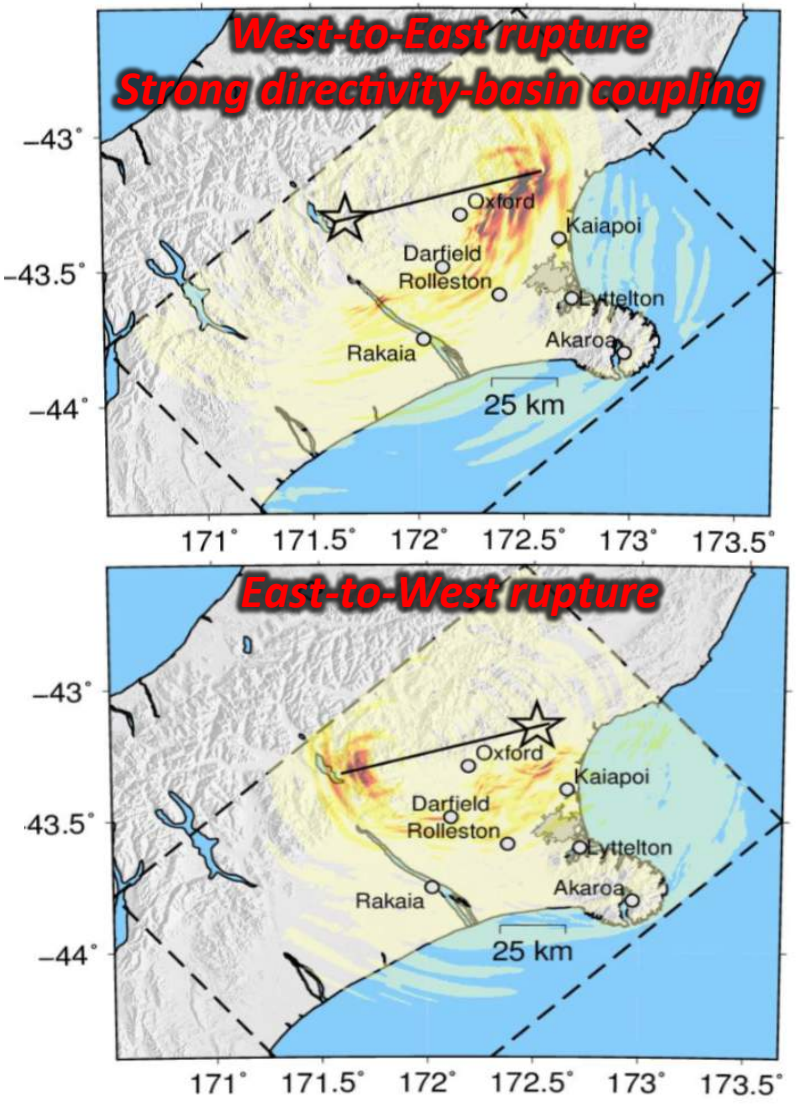
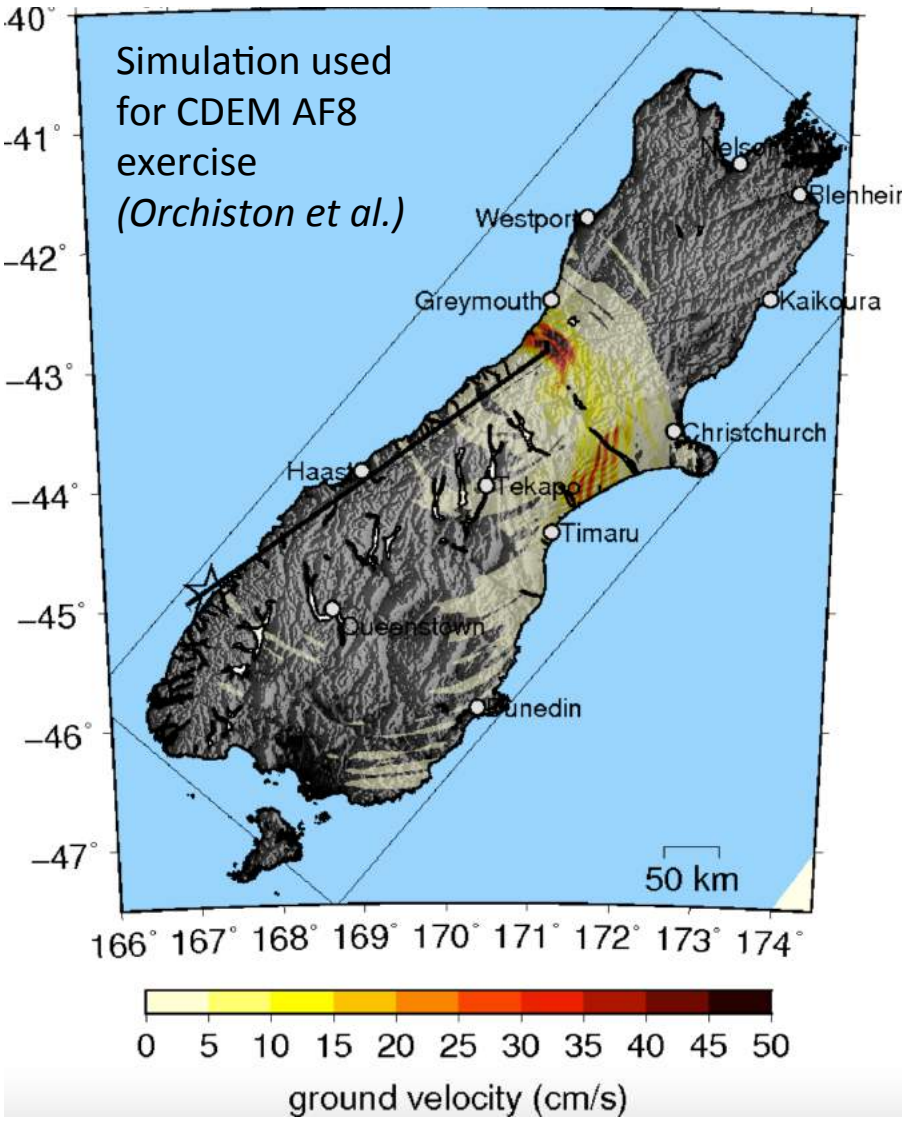
Mw7.2 Porters Pass Earthquakes



Mw8 Alpine Fault Earthquakes



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GMSV computational workflow

Bae et al.

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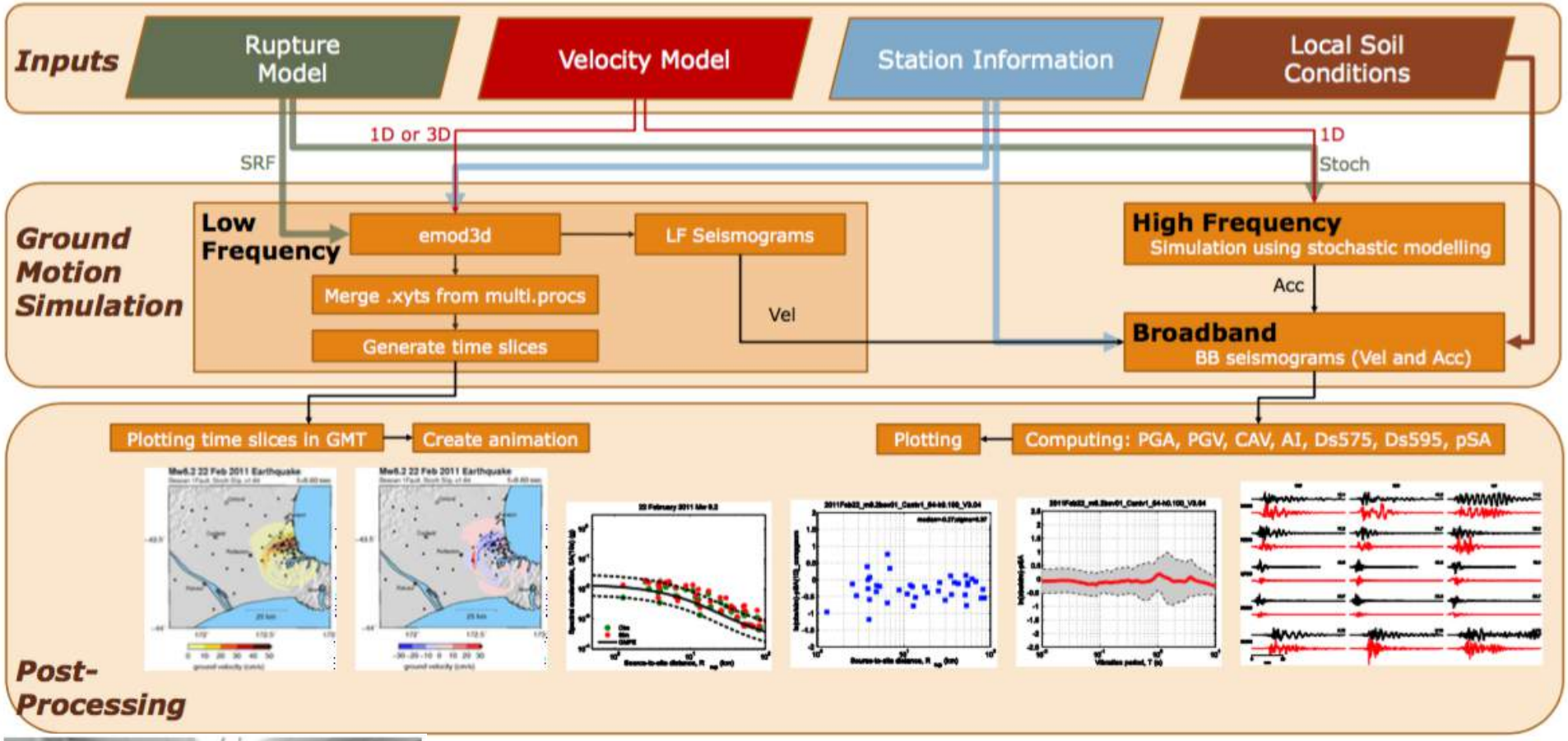

Implemented on NZ's two largest supercomputers

Real-time ground motion simulation

Strategic QuakeCoRE/NeSI/GeoNet partnership

GeoNet alert

Compute Rupture, Velocity model and approximate finite fault

Start GM simulation workflow

Simulation vs. Observation comparison

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