Flagship Project 1:
Ground motion simulation & validation

ground velocity (cm/s)

Observed
Simulated
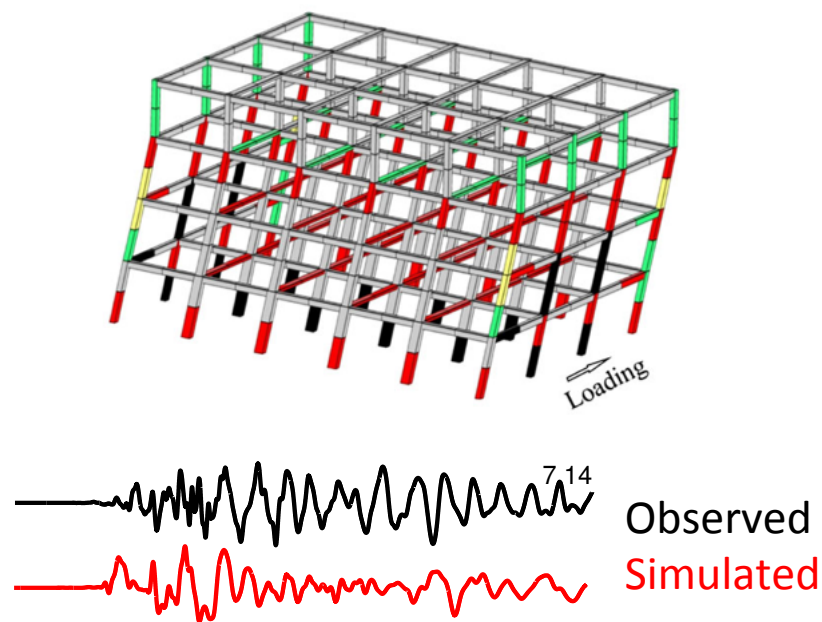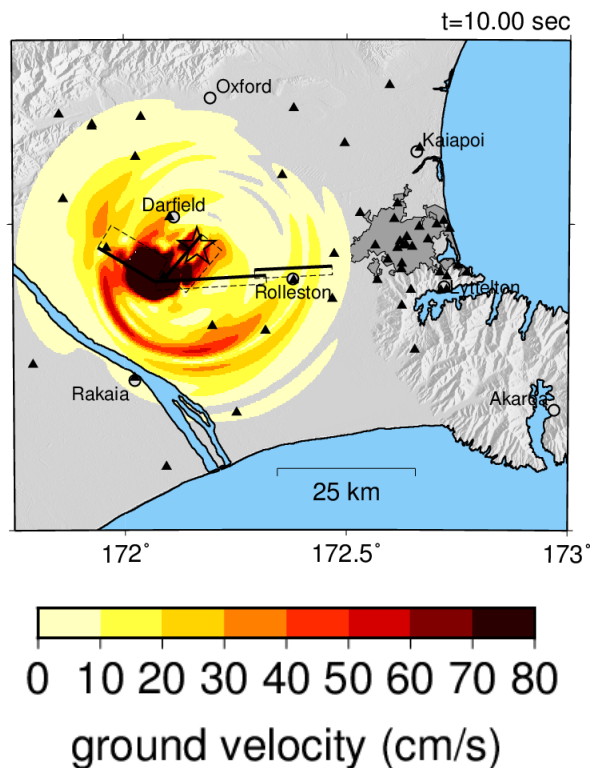
Brendon Bradley,

Flagship Project Leader & Deputy Director, QuakeCoRE

Spectrum of research

Ground motion modelling

Engineering utilization

Use in outreach and case studies

Velocity modelling

Site response & topo effects → Broadband sim methods

Kinematic rupture models

Ground Motion Simulation

Future EQs

Major Scenario Eqs

Probabilistic Seismic Hazard Analysis

Validation

Comparison w historic Eqs

Comparison w empirical models/GMPEs

(elastic/inelastic spectra, durations; MDOF nonlinear response etc)

Use of simulations in engineering design

(Hazard and GM selection)

Information feedback

Thrust Areas and 2016 funded projects

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

Thrust Areas gaps?

- **Gaps that are specific to NZ? (i.e. will only be resolved via NZ researchers)**
- **Gaps that are generic to simulations internationally?**

1. Simulation methods:

2. Velocity model development:

3. Nonlinear site and topographic response:

4. Application for major NZ EQ scenarios:

5. Uncertainties and PSHA:

6. Use of simulations in earthquake engineering analyses:

QuakeCoRE GMSV needs from Tech Platforms

what are the 'things' that we need from the tech platforms to advance this flagship?

(The Tech platform groups are currently looking to prioritize activities which will support QuakeCoRE research)
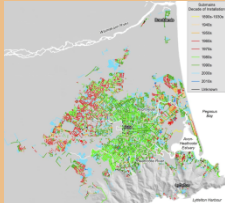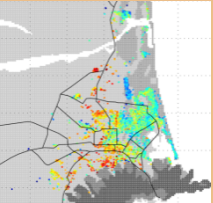
Technology Platforms

1. Large-scale Laboratory Facilities
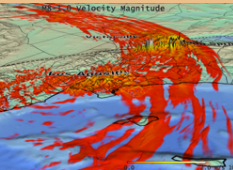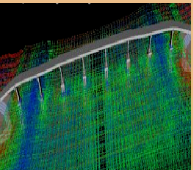

2. Field Testing & Monitoring Equipment

3. Multi-disciplinary Community Datasets

4. Simulation & Data Visualization

Research Themes

THEME 1
Seismic demands and consequent geohazards

THEME 2
Infrastructure component modelling

THEME 3
Infrastructure network interactions and interdependencies

THEME 4
Novel technologies, design philosophies, and decision-support tools

Flagship Projects

1. Ground motion simulation & validation
(Bradley)

2. Liquefaction impacts on infrastructure
(Cubrinovski)

3. Heritage, Safety and Economics: Addressing EPBs
(Ingham)

4. Repairable infrastructure
(Elwood/Pampanin)

5. Pathways to improved resilience
(Seville)

6. National critical infrastructure (with RNC-NSC)
(Wotherspoon)