DT1: ‘Ground motion’ first monthly meeting

Brendon Bradley

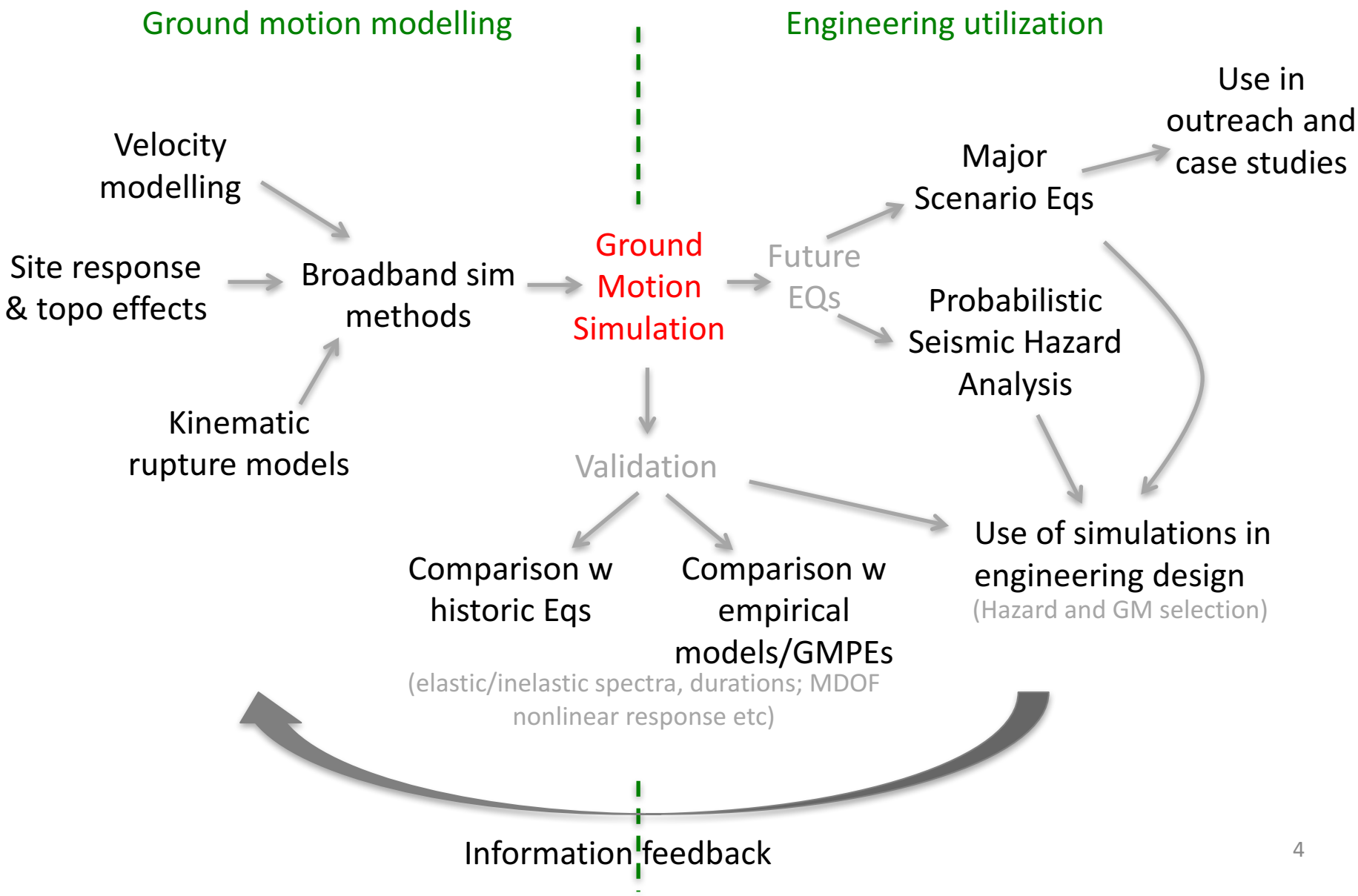
Monthly meetings

- *Odd months:* Three separate meetings for three strands of: 1) 'ground motion', 2) 'liquefaction', 3) 'fault rupture and slope stability'
- *Even months:* One 'joint' meeting where we look to develop our workplan on 'integrated geohazards' with a proposed case study in the Wellington region
- The aim of this two-month cycle is to allow low-level disciplinary discussions to occur as well as the multi-disciplinary interactions to gradually build up.

Odd month ‘ground motion’ meetings

- Nominally aim to run the same as FP1 meetings were held during QuakeCoRE Phase 1.
- Aim for the first few meetings (July, Sept 2021) to focus on:
  - Brief summaries of current work on-going &
  - Perspectives on where current work should progress today
  - Provocative views on significant changes to the status quo that we should pursue

Spectrum of research



Six activities of the 'ground motion' strand

Activities within strand 1 are framed around six key themes that collectively enable simulation-based ground-motion modelling with high predictive capability and precision.

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

Talks for today

- Current work / perspectives talks (5mins):
  - Chris de la Torre
  - Andrew Stolte
  - Robin Lee
  - Any others that have prepared slides?
- Provocative talks (?):
  - David Dempsey
  - Jeff Bayless
  - Brendon Bradley (only if time)
- Others:
  - Please let me know if you don't have anything ready for today, but are keen to talk in the next meeting (30th Sept)

Brendon perspectives on missing activities

1. Validation:
   A. Relatively soon (~ end 2021) we will have simulated all NZ events, so can compare apples-to-apples with empirical models.
   B. But our calculation inputs are often generic /ergodic – so a large focus will need to be directed to using validation results to refining event- and site-specific inputs (e.g., location / region specific)

Brendon perspectives on missing activities

2. f_{max} of LF calculation:
   A. All QuakeCoRE1 GM Sim research used f_{max} <= 1Hz with a focus on validation.
   B. Require attention to push to higher frequencies to test the current optimum transition frequency (will gradually increase as source and crustal models, and wave propagation physics modelled, keep getting better). Target 2Hz by end-2022, 4Hz by end 2024.
   C. Treatment of topography, plasticity, f-dependent anelasticity, crustal heterogeneities all become more important at these frequencies

Brendon perspectives on missing activities

3. Site response unification:
   A. Relatively little effort (globally, and in NZ) has been devoted to a unified treatment of site effects within simulations
   B. We collectively have done studies that consider site-specific wave propagation, but for limited events and sites
   C. Needs extension to entire validation dataset to understand range of situations where it can be reasonably used to improve predictions

Brendon perspectives on missing activities

4. Simulations with uncertainties:
   A. Essential component for use in PSHA
   B. Currently very limited effort (only one on-going PhS (Sarah Neill) exclusively focused on this in QC1)
   C. Easily enough content for 2-3 students working in parallel to address source, path, and site uncertainties and understand impacts on hazard

Brendon perspectives on missing activities

5. PSHA outputs with logic tree of simulations and empirical models

A. Cybershake NZ project in QC1 of empirical vs. simulation only results, and refinement of these simulation results
B. Need to transition to multiple version of simulations used in combination with multiple empirical models in a conventional logic tree framework
C. LT weights a function of earthquake scenario and location – determined based on validation (with considerations of extrapolation beyond validation dataset coverage)