

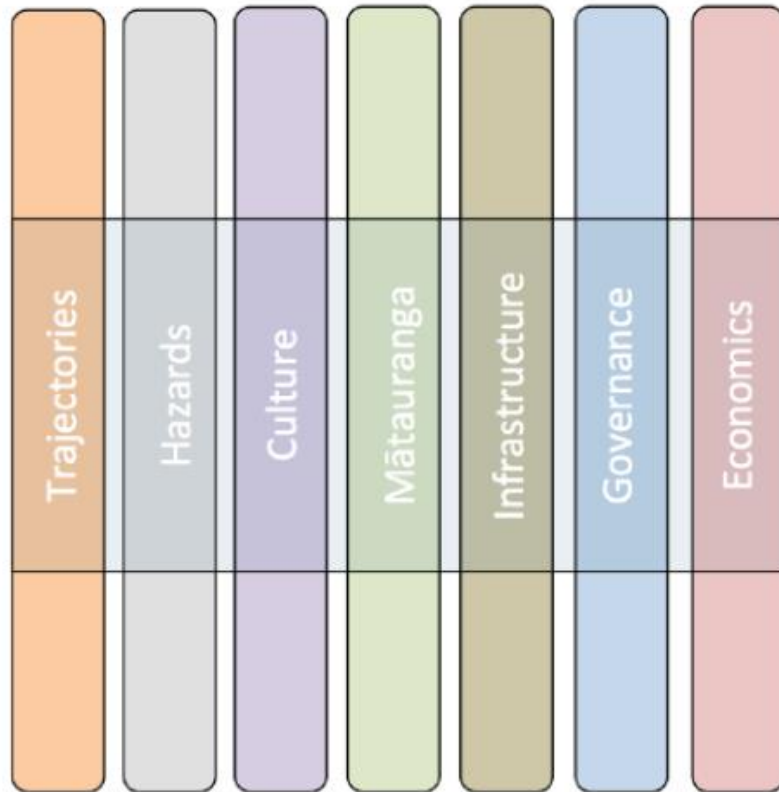
Resilience of Distributed Infrastructure 2015-2019

- Infrastructure Advisory Group Meeting
- Feb 2019
- More Info:
- <https://wiki.canterbury.ac.nz/display/QuakeCore/Special+Project+1%3A+Spatially-distributed+Infrastructure>

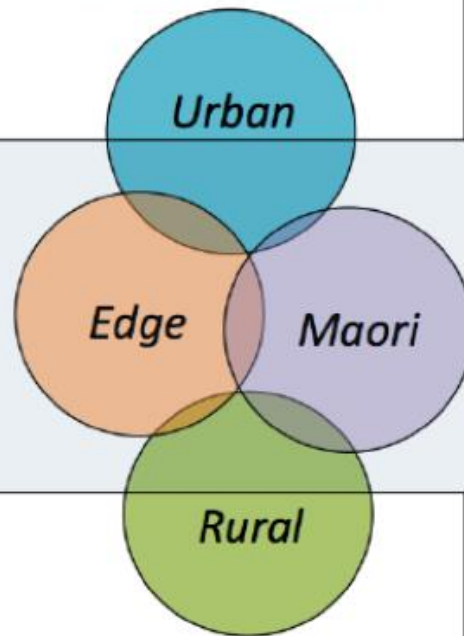
RNC1 Old Structure

Research Strategy – Resilience to Nature's Challenges

Underpinning Resilience Disciplines



Co-creation Labs



Priority Partnerships

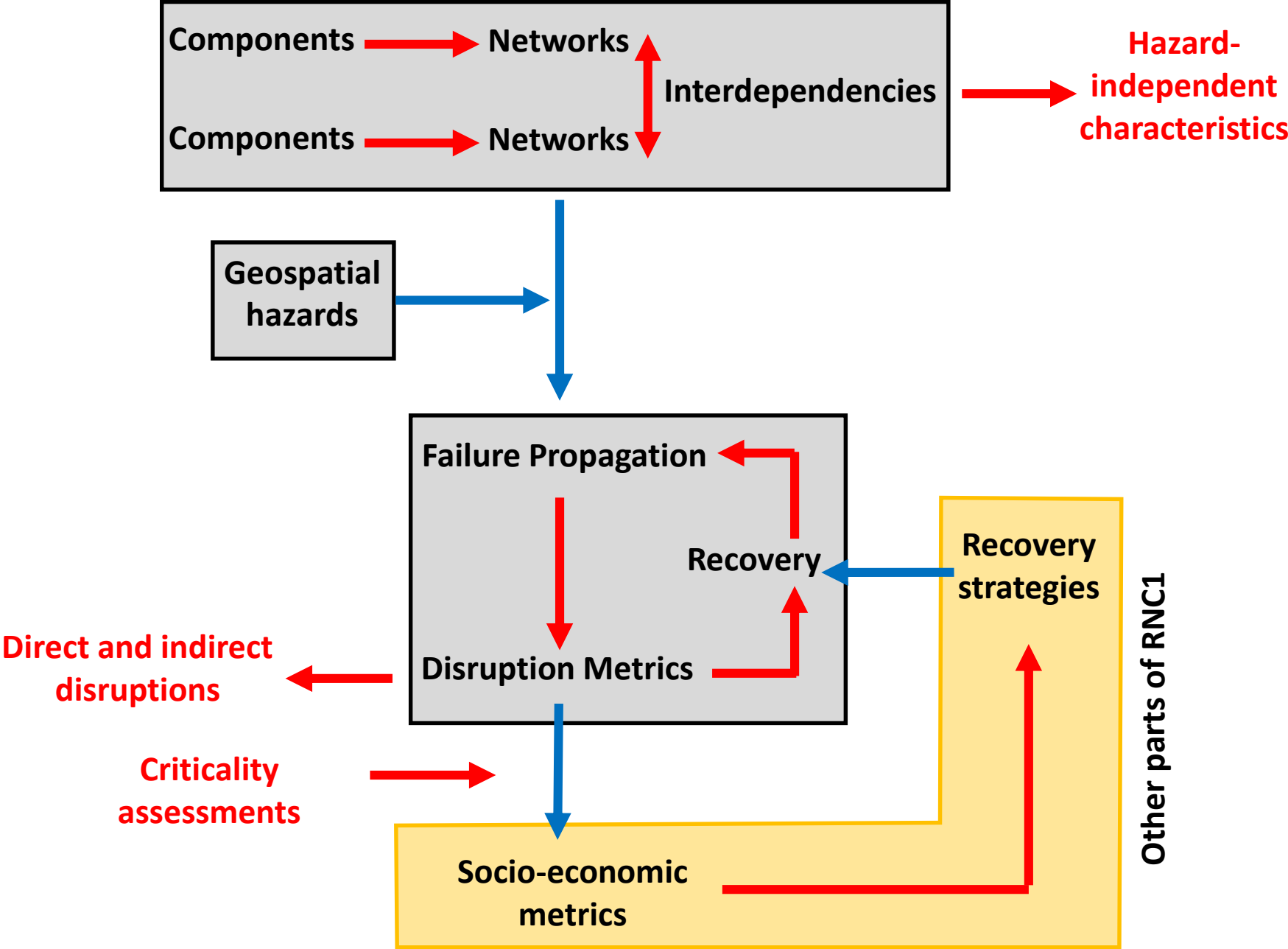
Resilience Pipeline

**A Resilient
New Zealand**



Innovative Enabling Technologies

Distributed Infrastructure Structure



Immediate Team

- Wotherspoon, Costello, Ranjitkar, Nair, Shamseldin, Whittaker, Chowdhury, Austin (UoA)
 - Bradley, Hughes, Blake, Giovinazzi, M. Wilson, T. Wilson (UoC)
 - Ivory (WSP-Opus)
 - Stevenson (Res Orgs)
 - Crawford-Flett (QC)
 - Paulik, Popovich (NIWA)
 - Uma (GNS)
 - Fairclough (Neoleaf)
-
- Strong collaborations with QuakeCoRE, AF8, NIWA throughout and with wider ground of reseachers

Infrastructure Statistics to Date

- Students (direct)
 - 10 PhD
 - 6 Masters
 - 2 Post-Doc
 - 25+ undergraduate projects
- Over \$1 million co-funding
- Over 50 partner meetings
- Over 50 presentations
- 20+ publications/reports

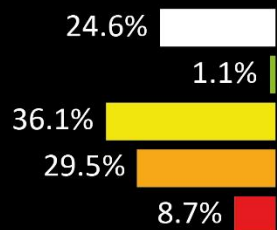
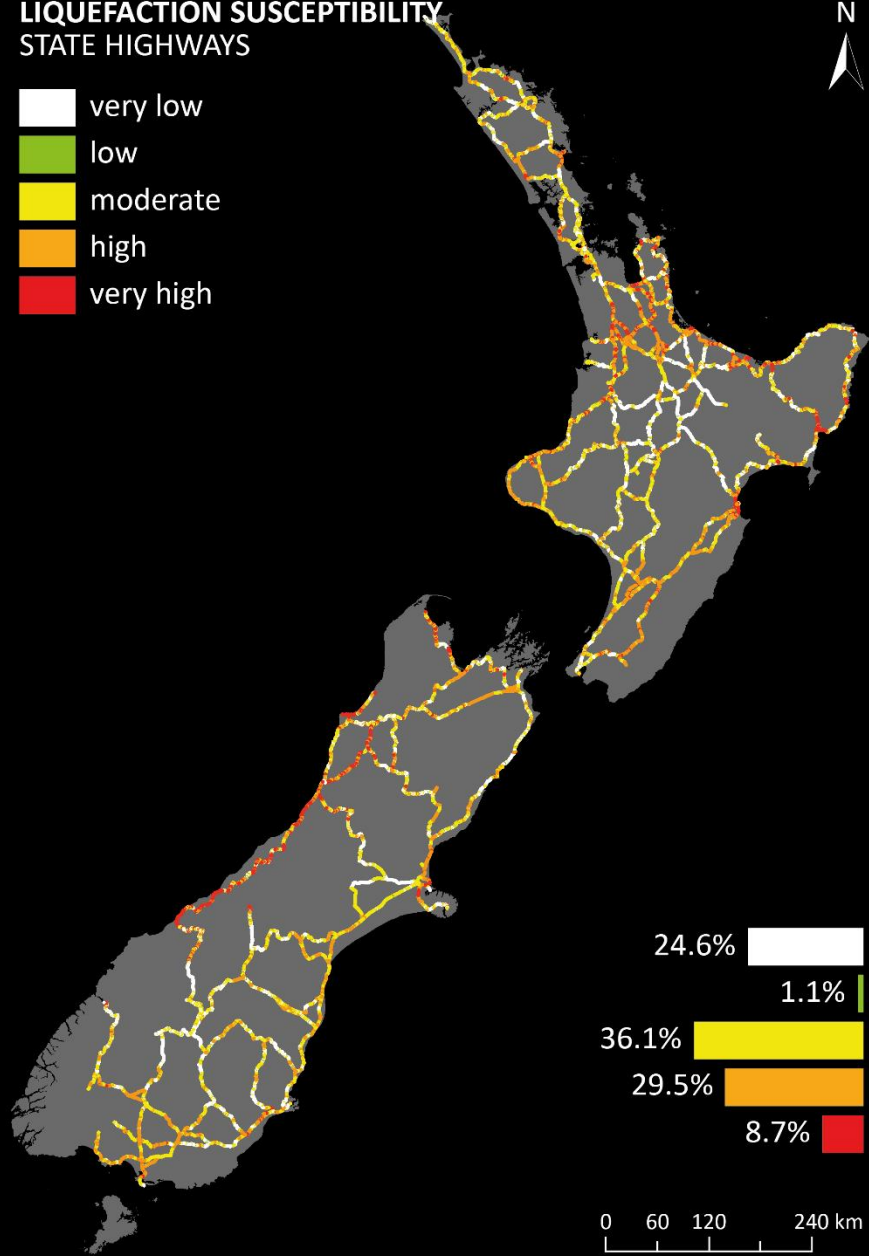
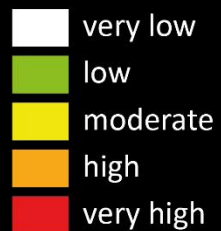
Research Summaries

Geospatial Hazards

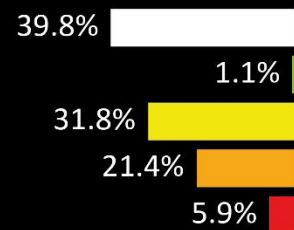
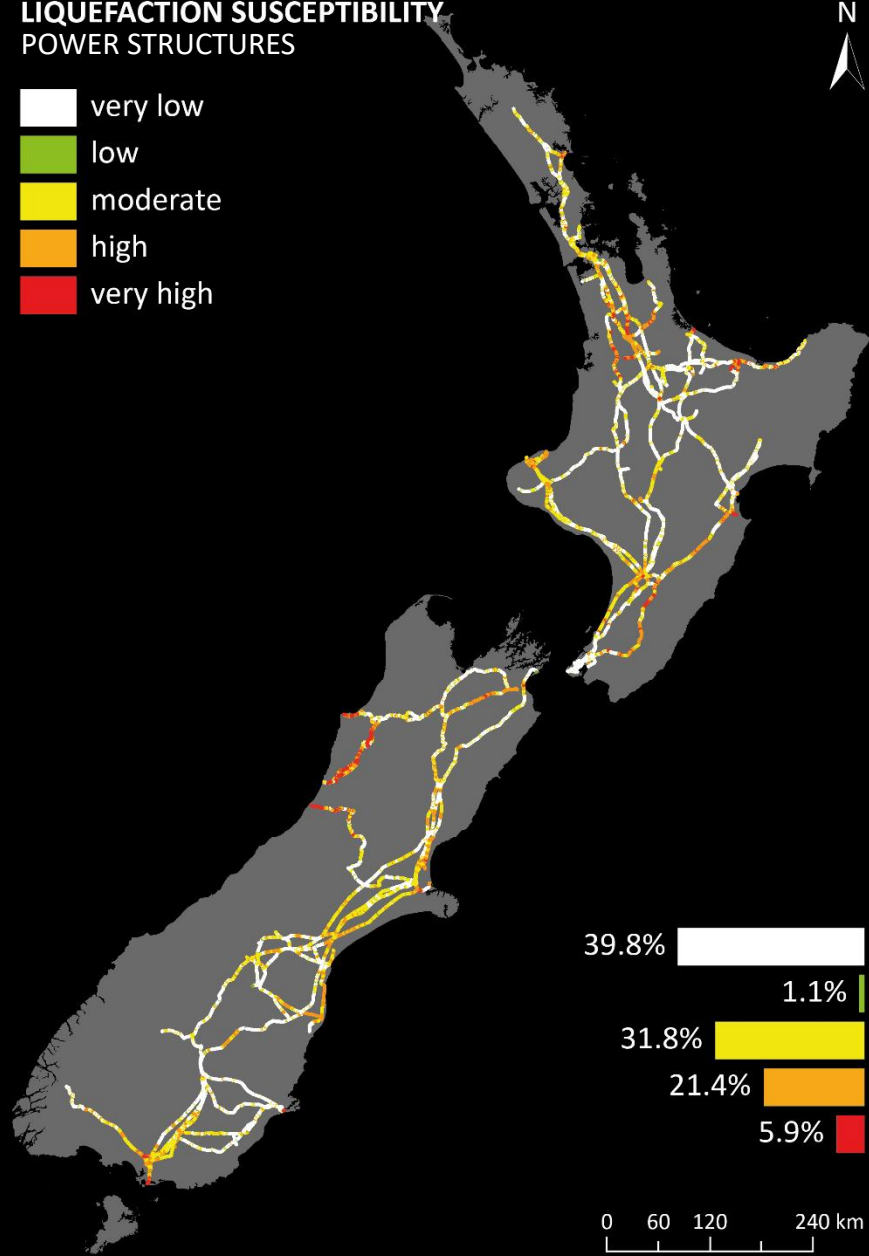
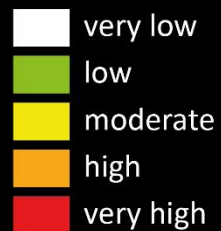
- National/regional geospatial hazard simulation – ground shaking, liquefaction, landslides
 - Automated mapping onto infrastructure networks for scenarios/return period shaking

Mid 2019

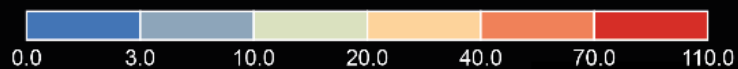
LIQUEFACTION SUSCEPTIBILITY STATE HIGHWAYS



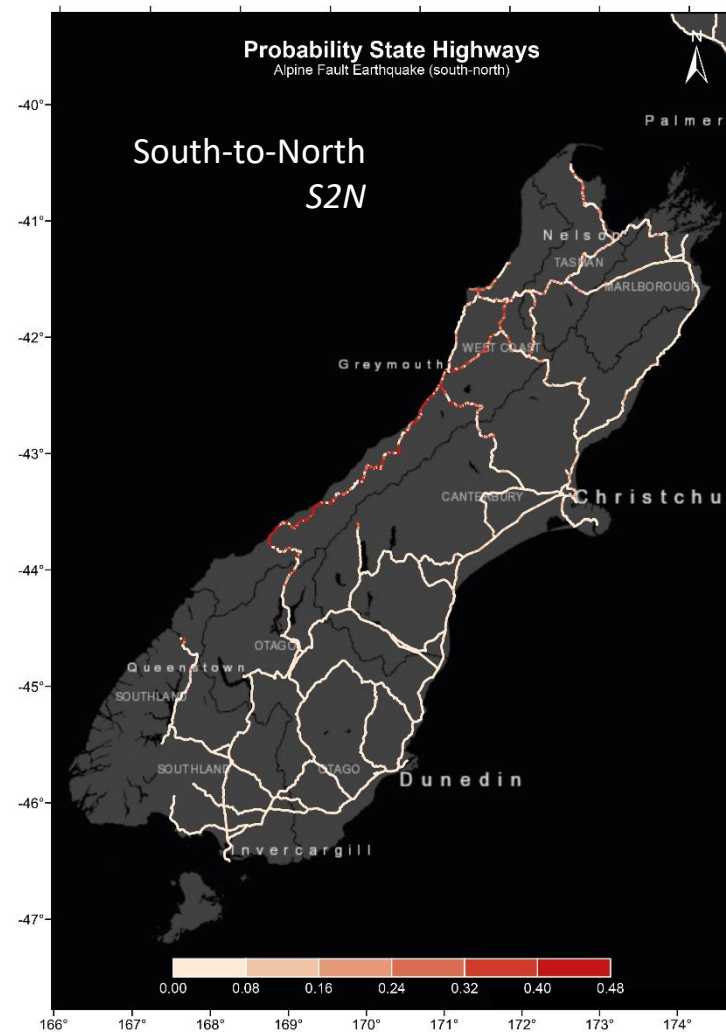
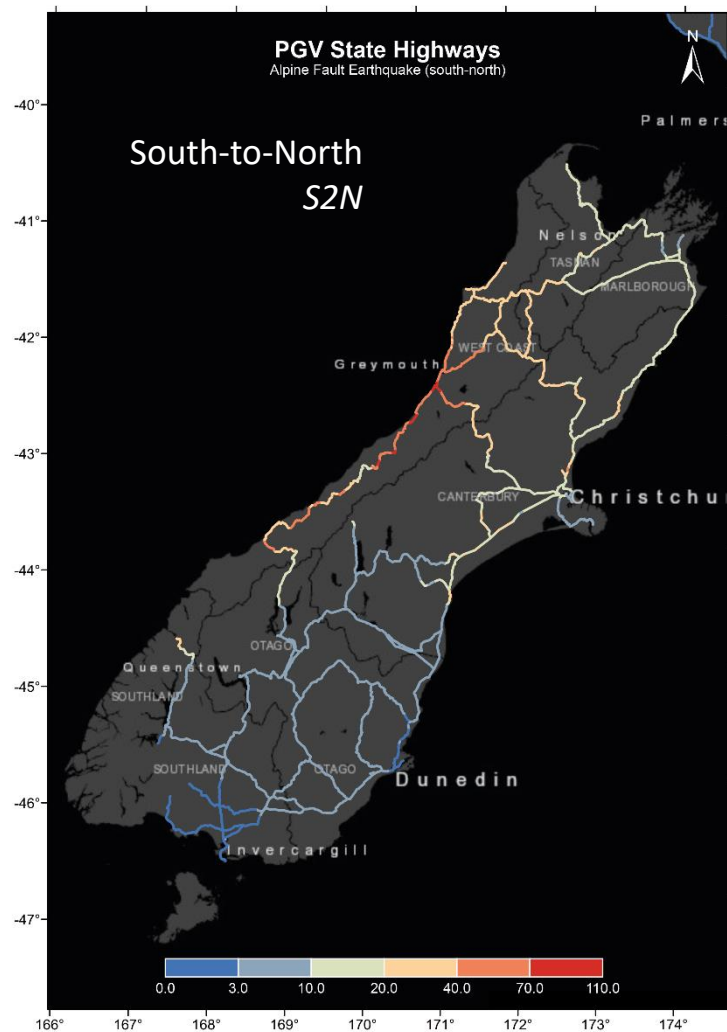
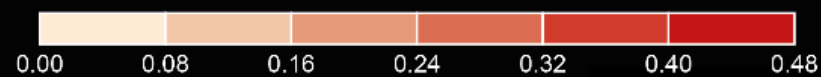
LIQUEFACTION SUSCEPTIBILITY POWER STRUCTURES



PGV (cm/s)



Liquefaction Probability



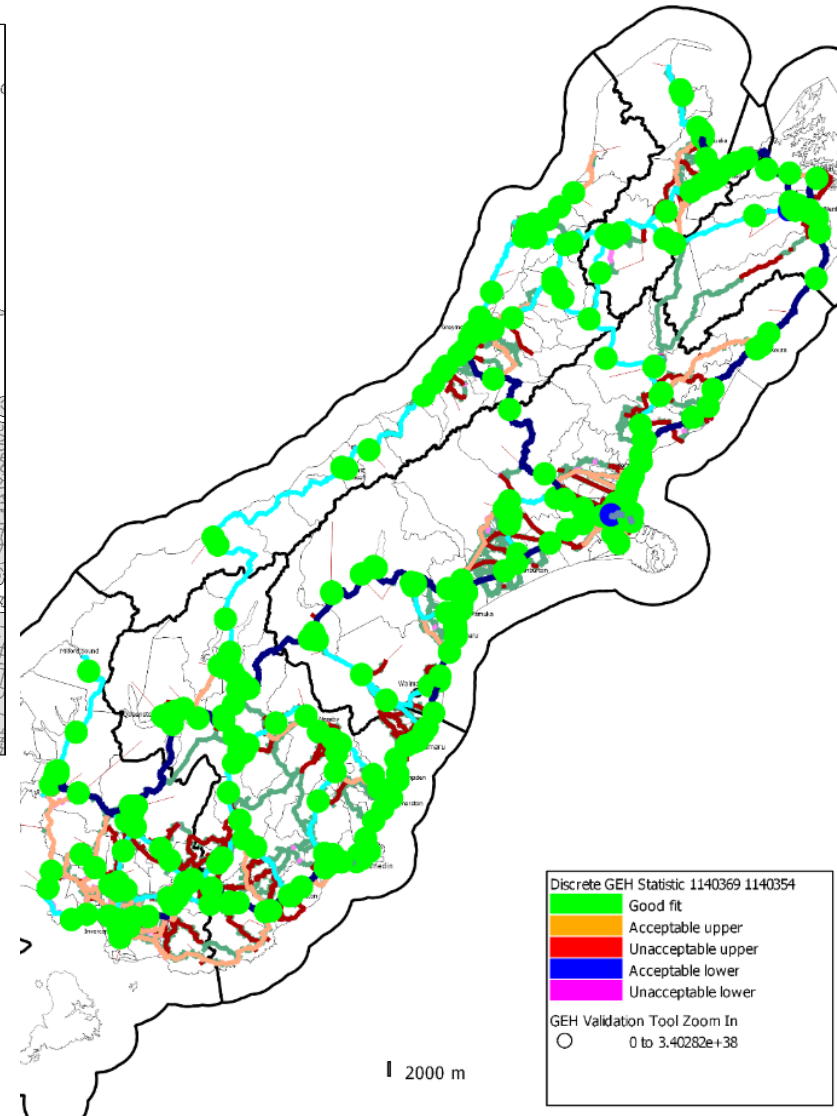
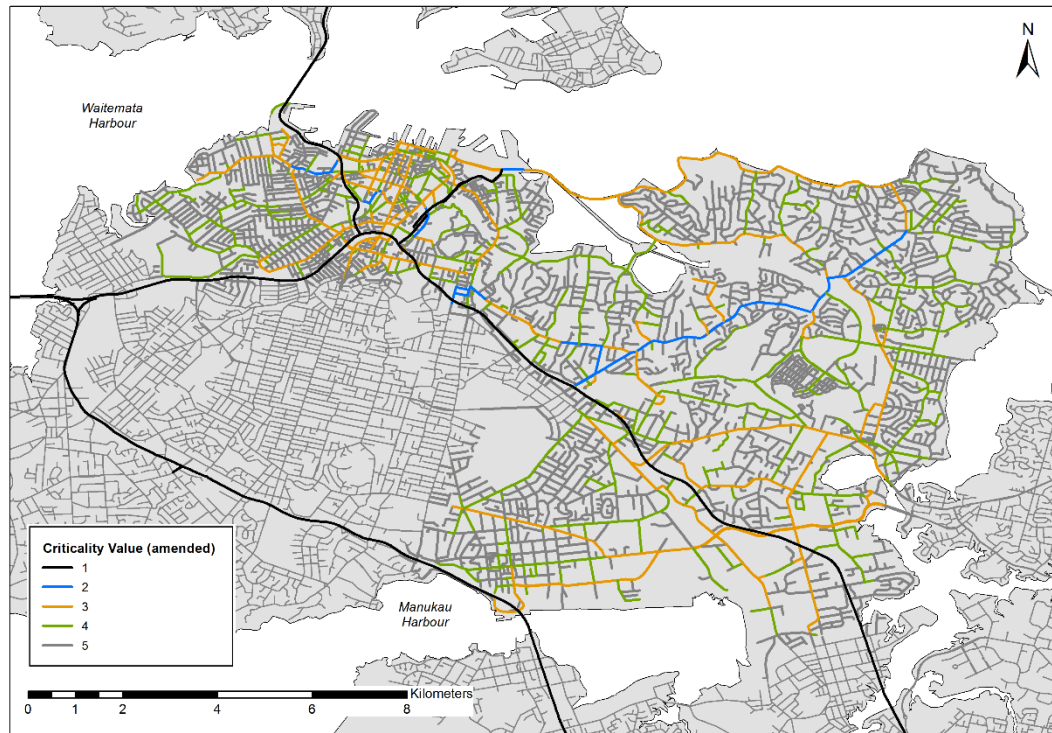
Transport

- MoT Kaikōura project **COMPLETE**
 - An evaluation of transport sector responses to the Kaikōura earthquake, New Zealand
- Urban Road Criticality Framework (AT) **COMPLETE**
 - Update of existing framework to account for critical facility access
- Operational Resilience Assessment of a Rural Road Network (NZ Transport Agency) **End 2019**
 - South Island Transport Model Complete
 - Kaikoura EQ and Alpine Fault
- Auckland Transport Model (AT, NZ Police) **End 2019**
 - Model Complete
 - Volcanic eruption evacuation

Transport

- NZ specific bridge fragility models (NZ Transport Agency)
 - Historic seismic performance **COMPLETE**
 - Seismic and tsunami loading **End 2019**
- Port Tsunami Exposure (Port Companies)
 - Scenario Propagation Modelling
 - Component Mapping**COMPLETE**

Transport



Electricity

COMPLETE

- Electric power distribution system resilience modelling toolbox (Westpower and Transpower)

- A Framework for Islanded Microgrid Operation after Hazard Events (Westpower)

Mid 2019

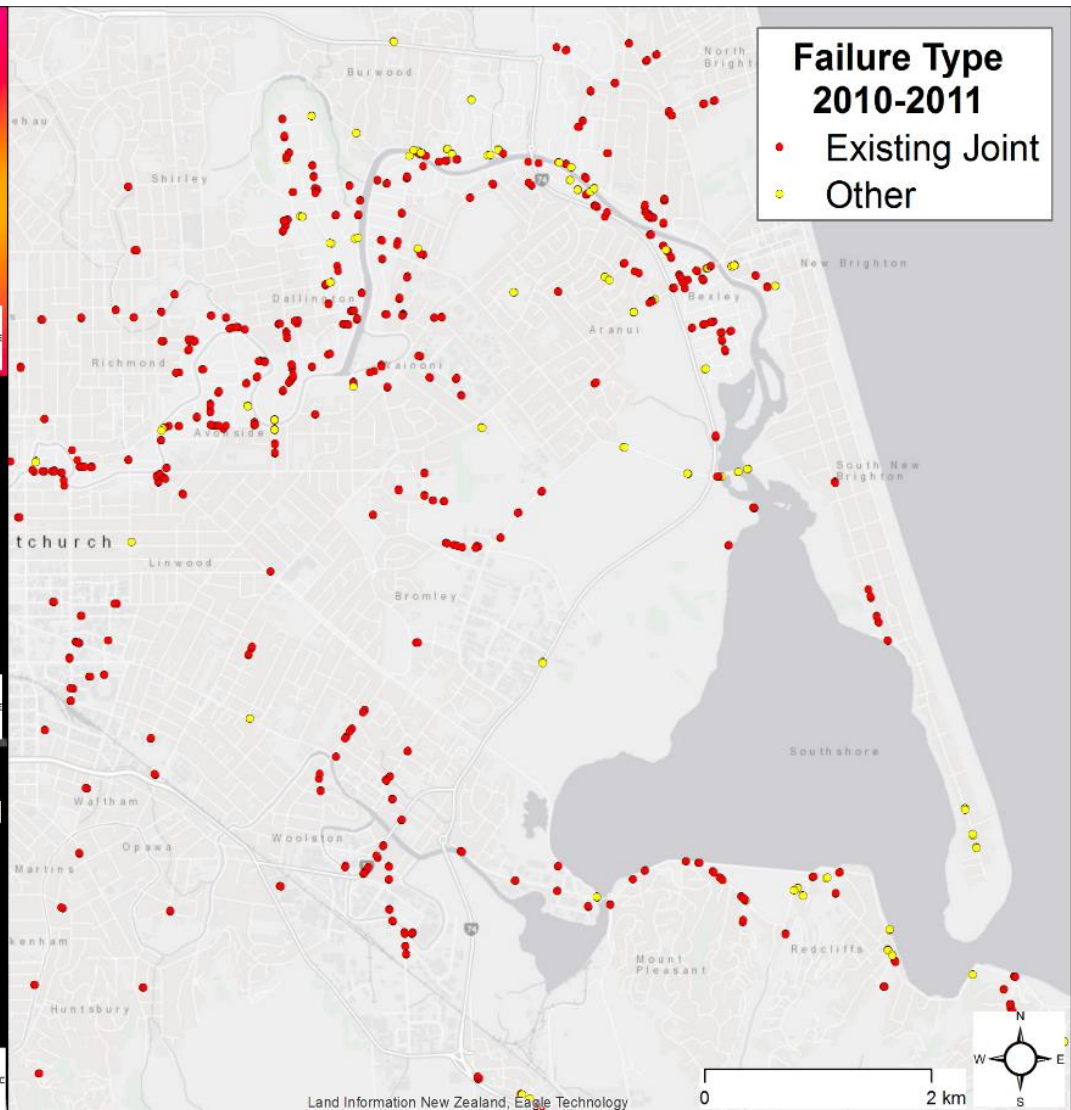
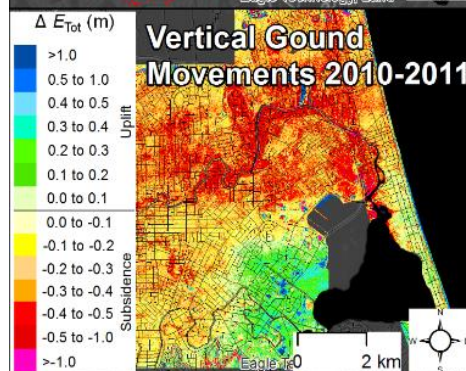
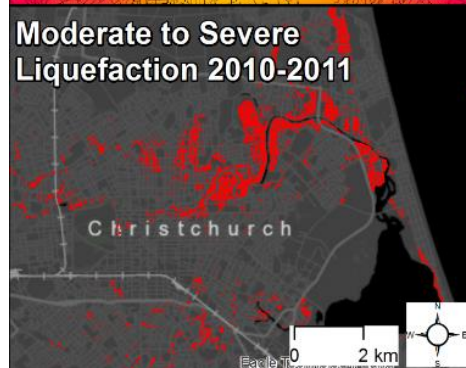
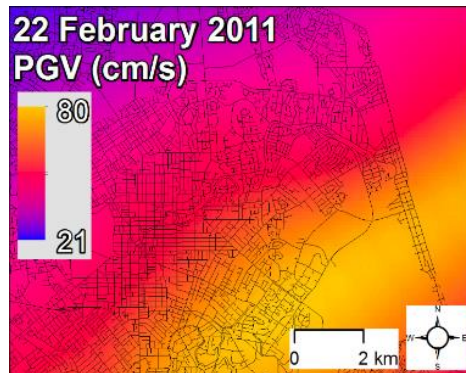
- Effective Power Restoration Practices following extreme natural hazards (Westpower)

End 2019

Electricity

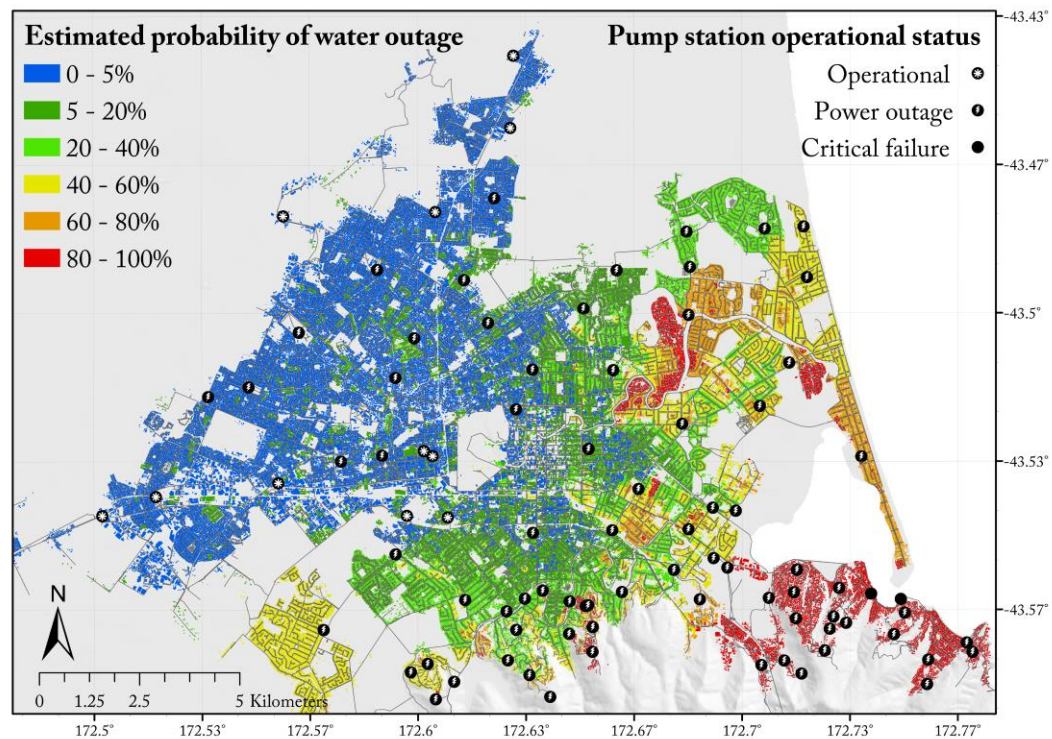
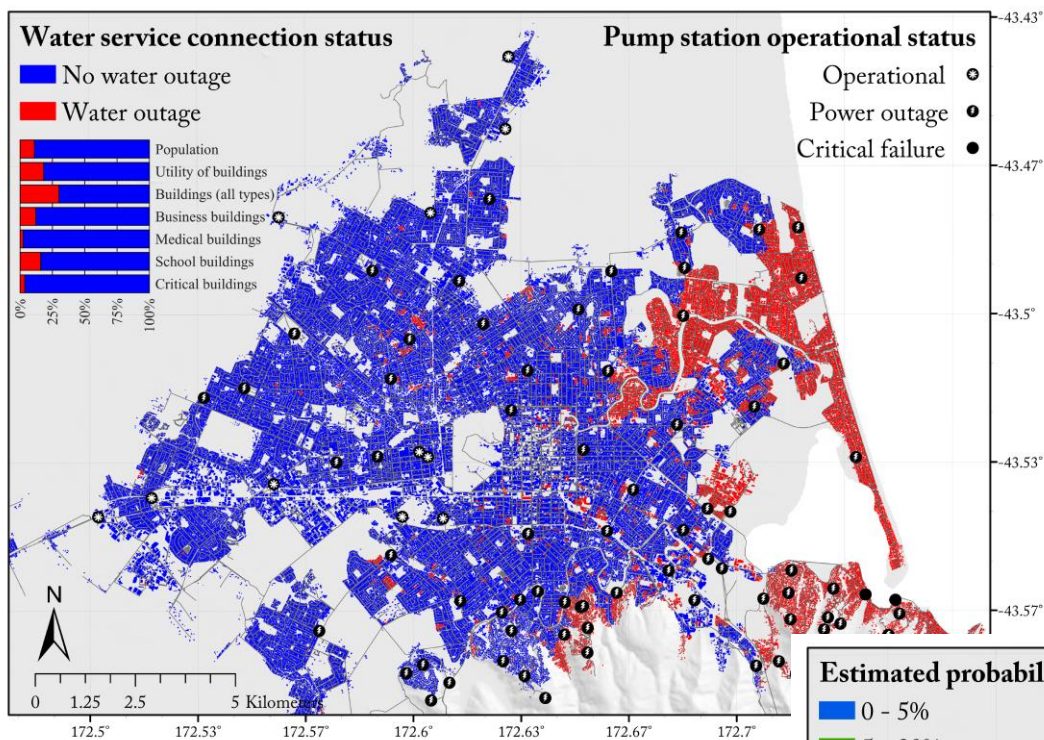
- Seismic fragility of buried HV cables (with Orion) End 2019
 - Development of performance dataset from Canterbury earthquake sequence
- Electric power criticality and resilience (EEA) Mid 2019
 - Build on Transport and other frameworks
- Tsunami impacts (Orion) Mid 2019
 - Component fragility modelling - electricity
 - Electricity network and recovery 2020
- Wind farm hazard assessment (initial) COMPLETE

Electricity



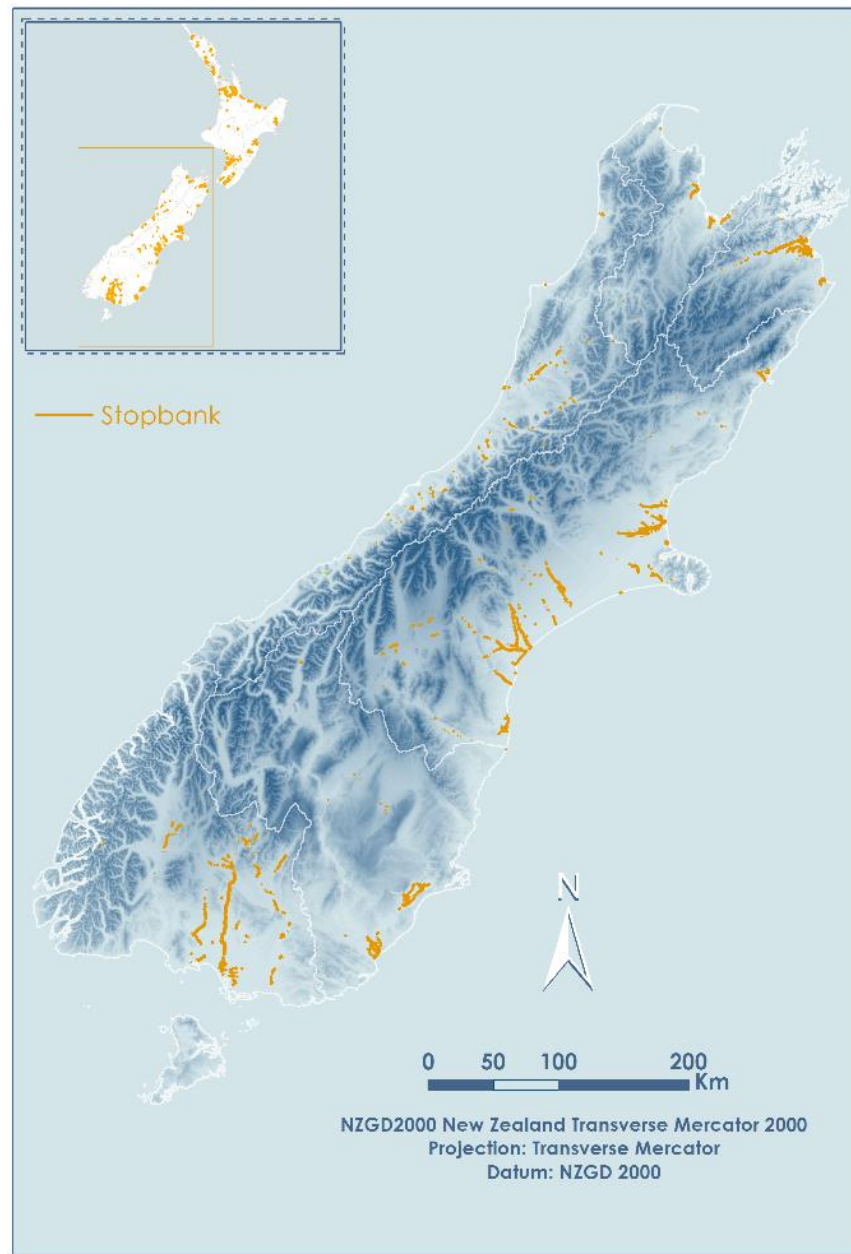
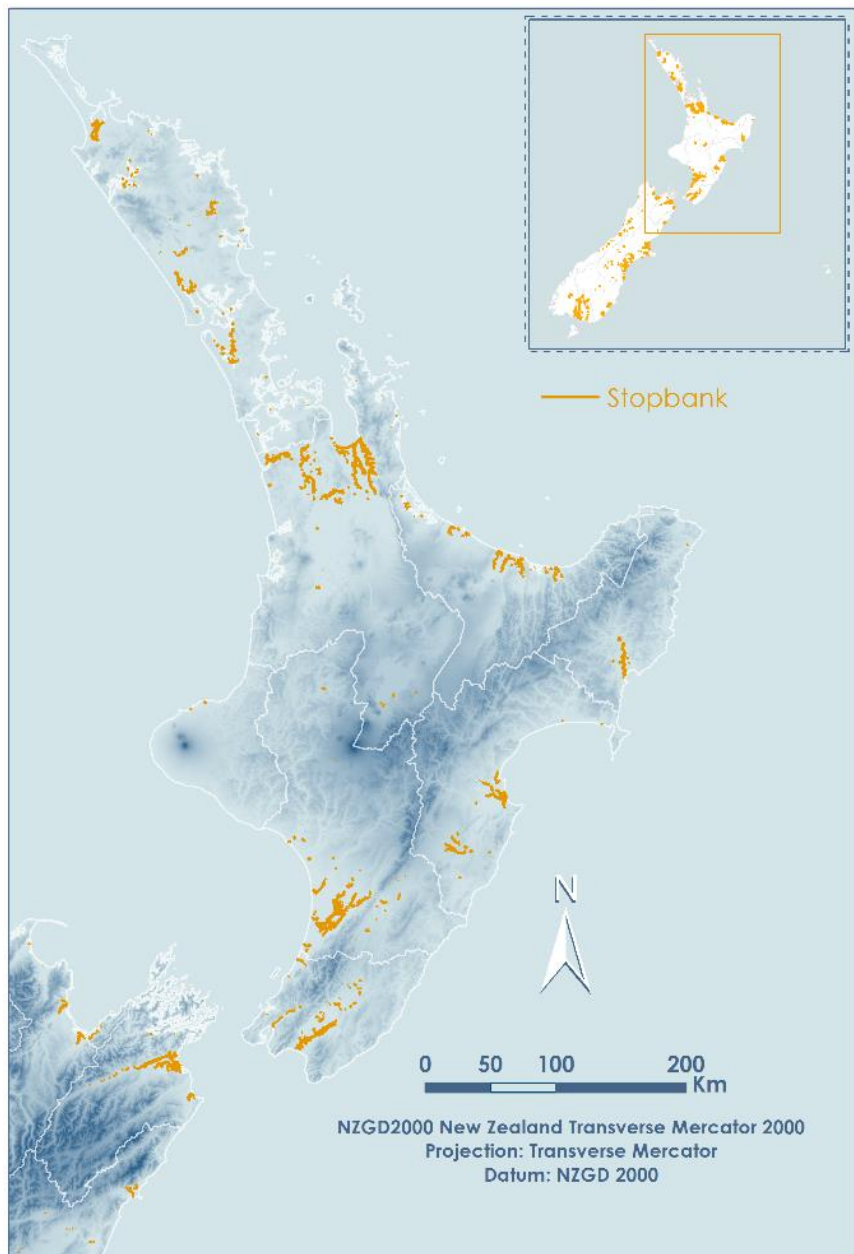
3 Waters

- Potable water (with CCC)
 - Development of seismic fragility models from Canterbury earthquake sequence dataset **Complete**
 - Development of system recovery tool for Christchurch network **Complete**
- Wastewater (with CCC)
 - Dataset collation from Canterbury earthquake sequence and fragility model development **Early 2019**
- Stormwater Resilience (with AC)
 - Technical resilience framework for pipe networks **Complete**
 - Resilience indicators for network structure **Complete**



Flood + Flood Defence

- Flood Defence (River Managers and Tasman DC)
 - NZ Inventory of Stopbanks (NZIS) v1 **Complete**
 - NZIS Geotechnical data and incident database **End 2019**
 - Influence of undocumented stopbanks on flood routing and catchment performance **Early 2019**
 - Stopbank failure mode modelling **2020**
- Infrastructure flood vulnerability models **1st stage COMPLETE**



Telecommunications

Mid 2019

- Telecommunications performance in Canterbury and Kaikōura EQs (Chorus)
- Framework for dynamic reconfiguration of wired and wireless communication systems

2019-2020

End-to-End Simulation

- National Scale Interdependent Infrastructure Model

COMPLETE

- Incorporation of electric power network process models into interdependency models

Mid 2019

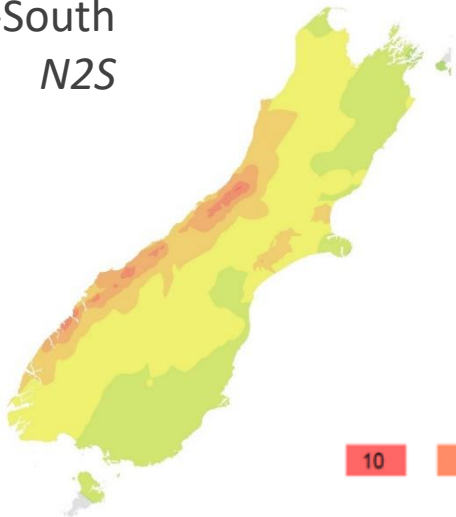
- Linkage of model outputs into MERIT

Test Case –
Corridor
Forums

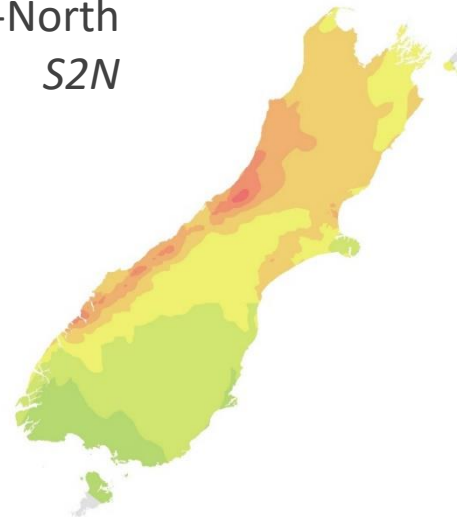
- City scale interdependency modelling

End 2019

North-to-South
N2S



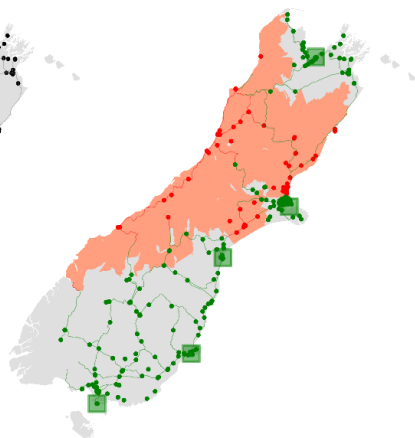
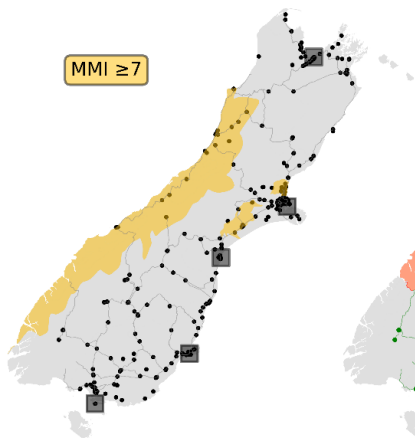
South-to-North
S2N



Shaking intensity (MMI)

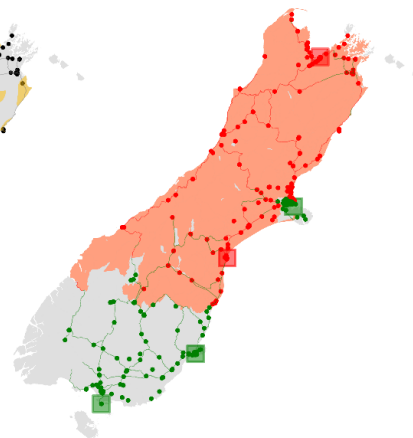
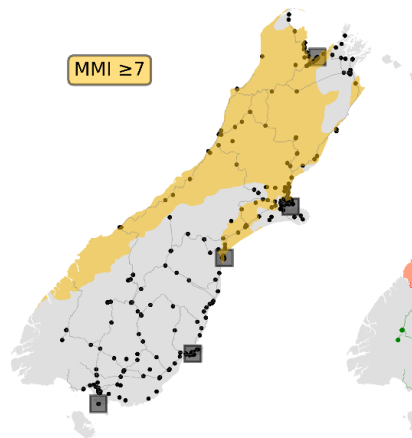
Asset Exposure

Extent of Disruption



Asset Exposure

Extent of Disruption



Socio-economic

COMPLETE

- Critical infrastructure impacts & adaptations in small towns (CDEM SI, CELG)
 - Kaikoura earthquake
- Evacuation behaviour in Auckland (AC) 2019-2020
- Transient Population Model (CDEM SI) Mid 2019
- Marae adaptations following infrastructure outages (various iwi) Mid 2019