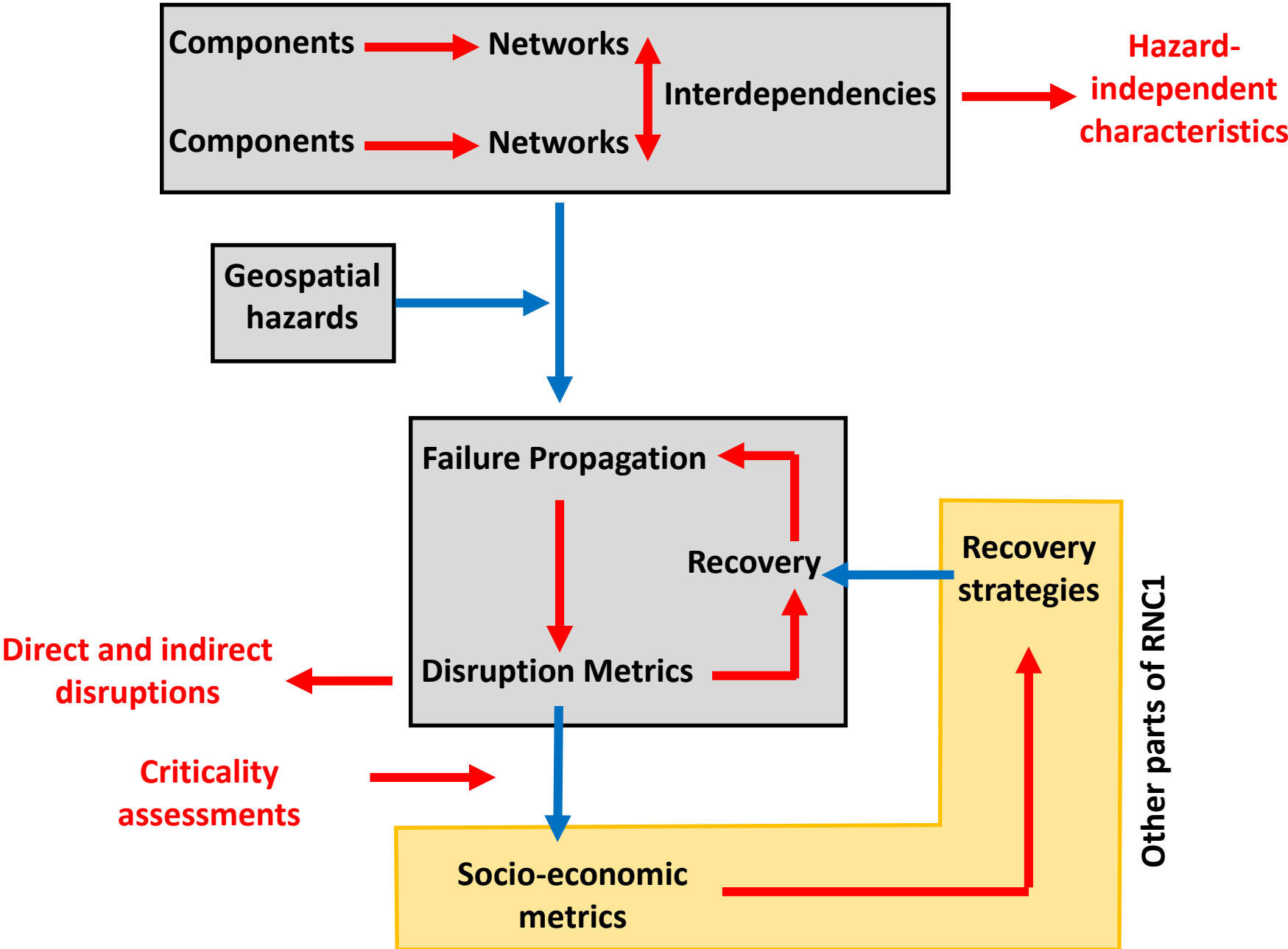


Resilience of Distributed Infrastructure 2015-2019

Distributed Infrastructure Structure



Research Collaboration

Power systems engineering	Organisational resilience	Geotechnical engineering	Geospatial analysis	Asset Management
Telecommunication engineering	Hydrology	Coastal engineering	Natural hazard response	Infrastructure engineering
Volcanology	Seismology	Transportation engineering	Economics	Statistics
Water resources engineering	Computer science	Risk and resilience	Engineering Science	
	Geohazards	Human behaviour	Structural engineering	

Research-Industry Collaboration

- Real-world data, real-world complexity, real-world perspective

Infrastructure Advisory Group



CHORUS



Orion



Infrastructure Statistics to Date

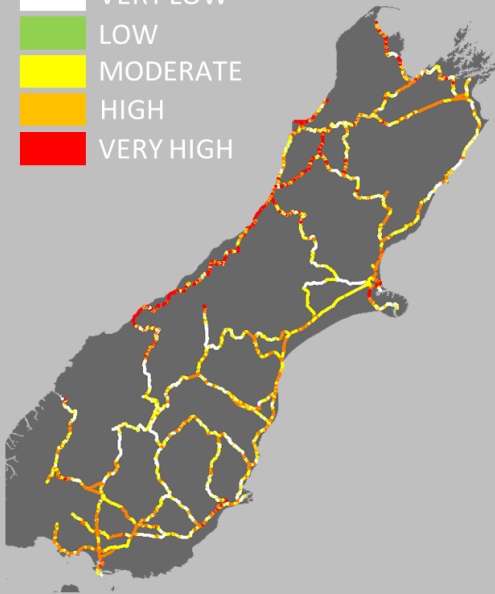
- Students (direct)
 - 10 PhD
 - 6 Masters
 - 2 Post-Doc
 - 25+ undergraduate projects
- Over \$1 million co-funding (\$1.5 million base)
- Over 60 partner meetings
- Over 60 monthly meeting presentations
- 20+ publications/reports (more in progress)
- Multiple paper and presentation awards

Geospatial Hazards

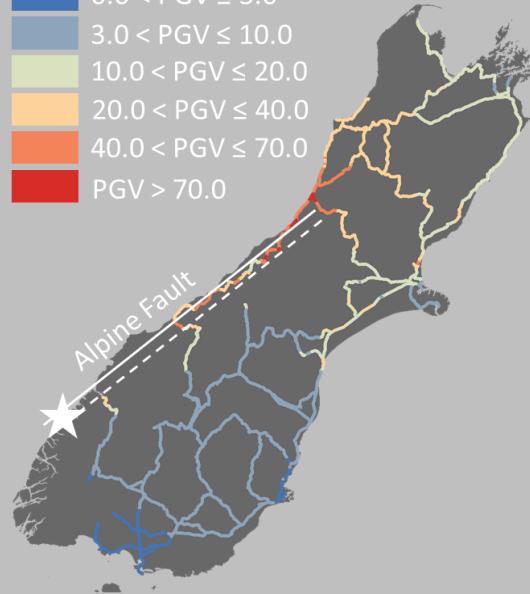
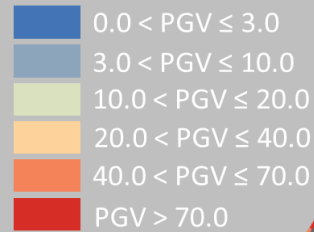
- National/regional geospatial hazard simulation – ground shaking, liquefaction, landslides
 - Automated mapping onto infrastructure networks for scenarios/return period shaking **COMPLETE**
- Port Tsunami Exposure **COMPLETE**

Geospatial Hazards

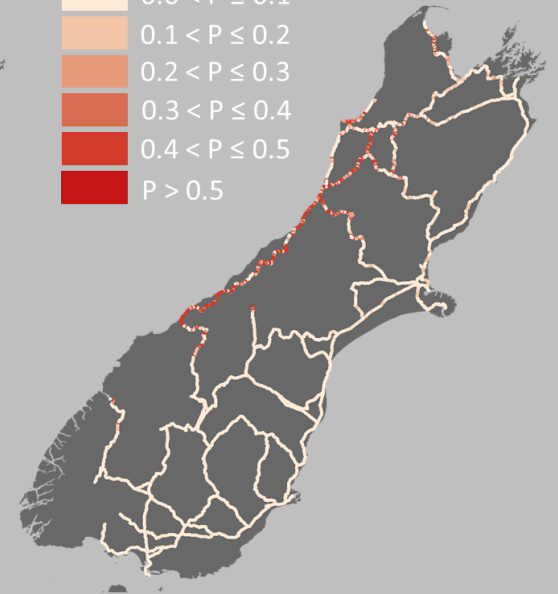
LIQUEFACTION SUSCEPTIBILITY



GROUND SHAKING



LIQUEFACTION PROBABILITY



Kaikōura EQ Rapid Response

- Multiple post event journal papers

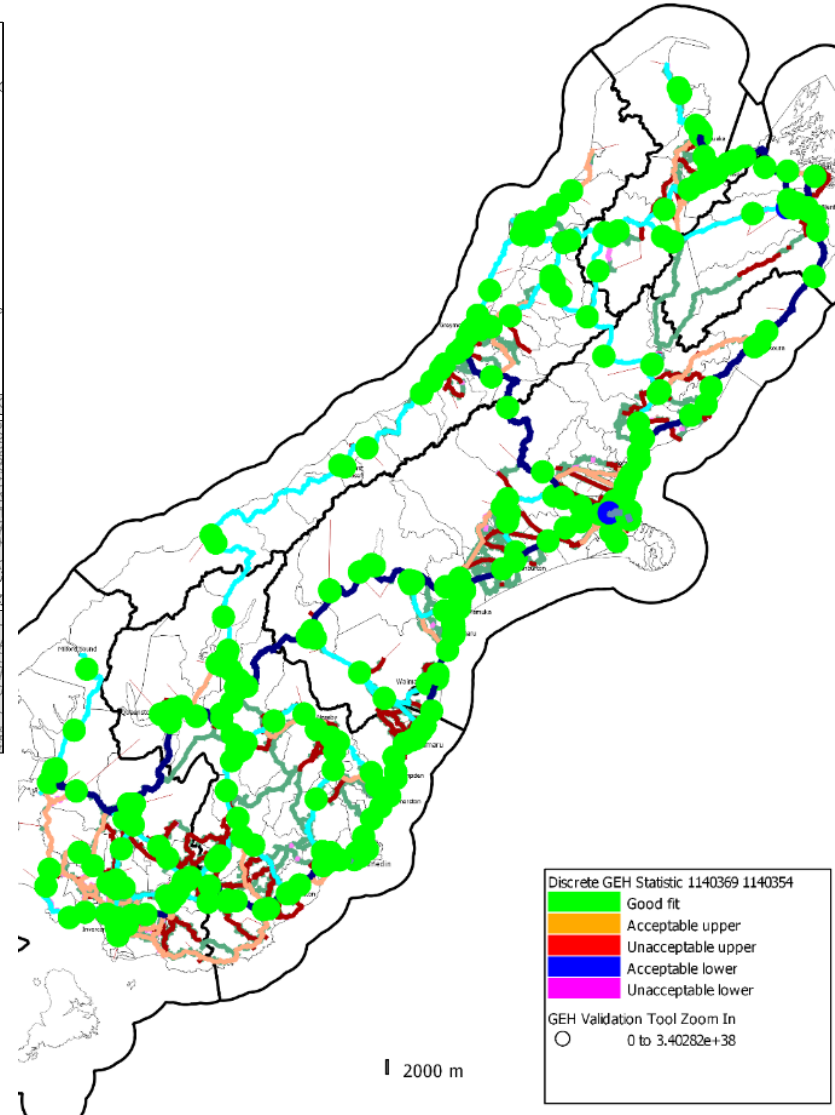
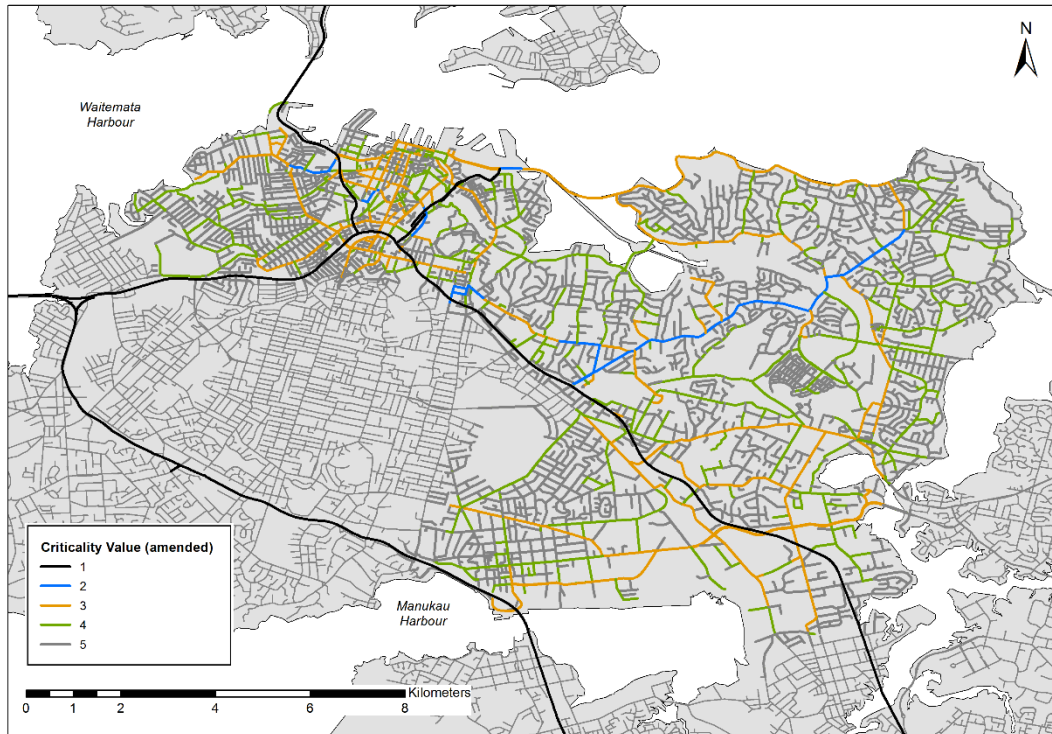
COMPLETE



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) **Mid 2020**
 - South Island Transport Model Complete
 - Kaikoura EQ and Alpine Fault
- Auckland Transport Model (AT, NZ Police) **Mid 2020**
 - Model Complete
 - Volcanic eruption evacuation

Transport

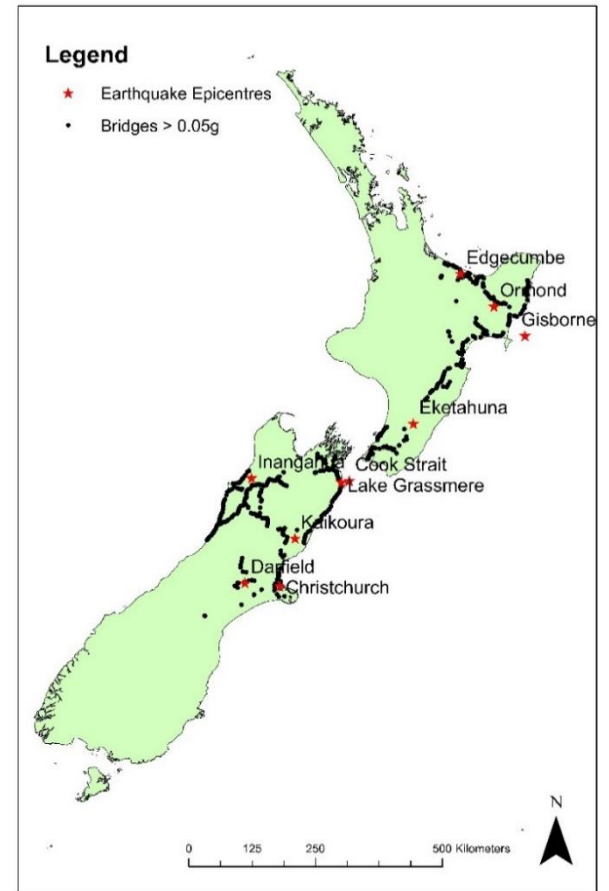
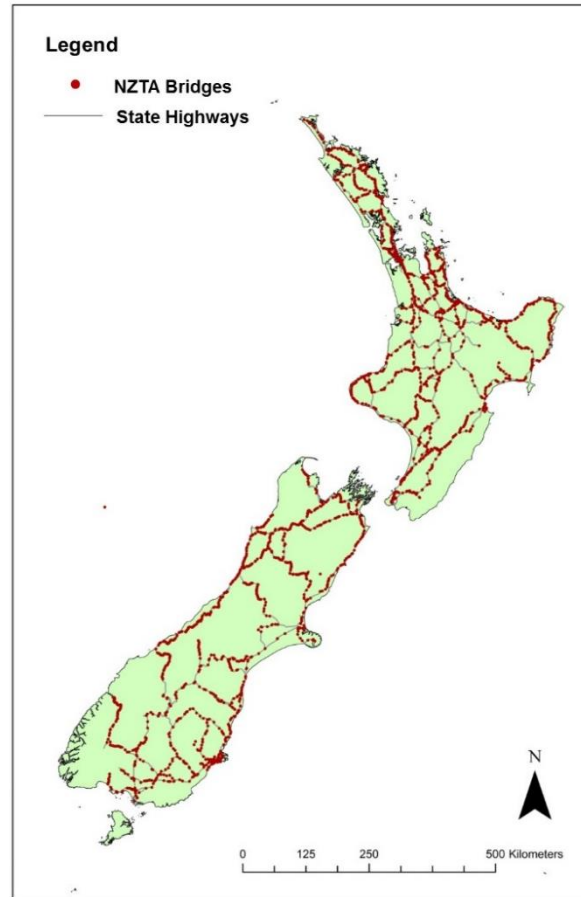


Transport

- 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



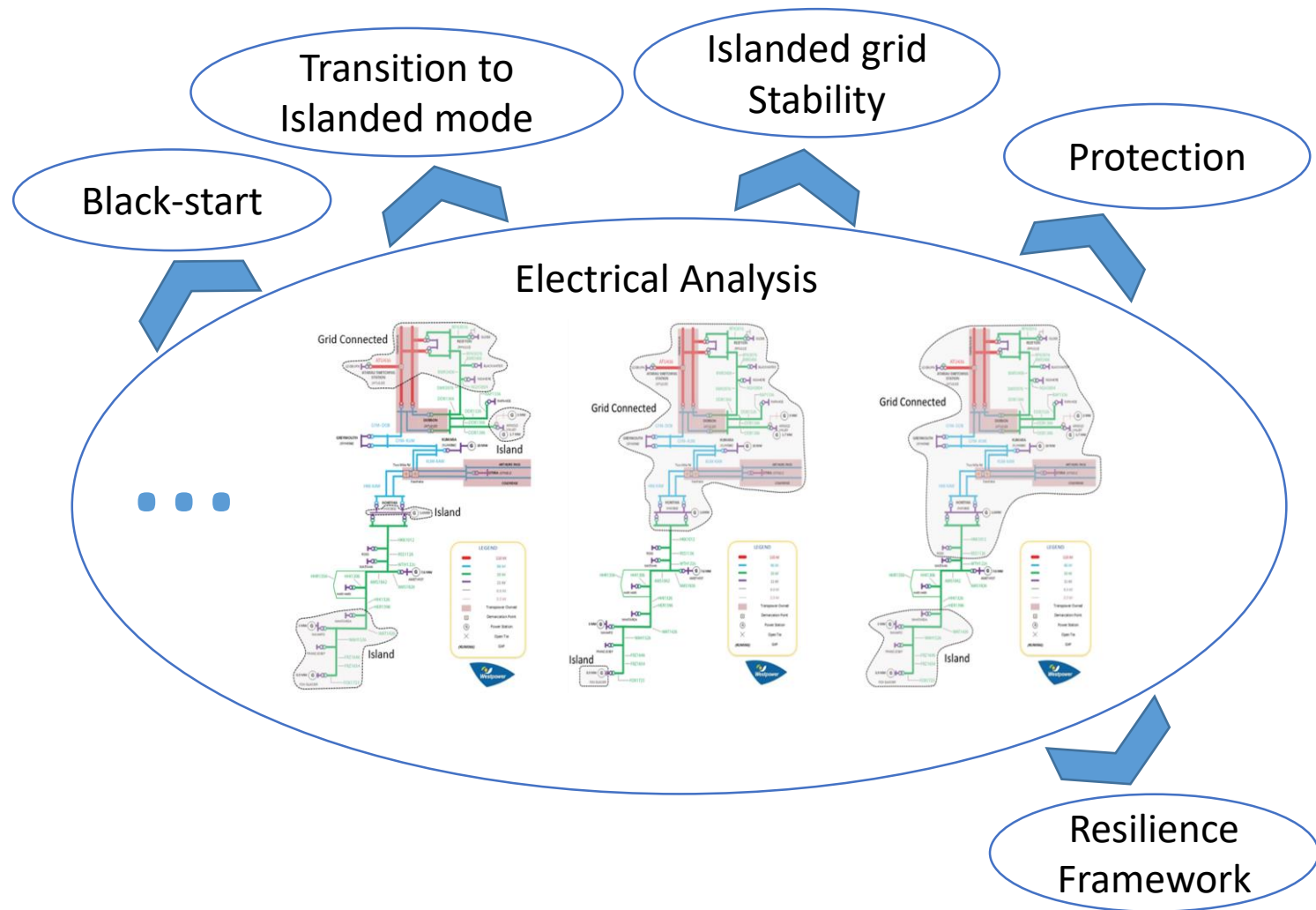
Electricity

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

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

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

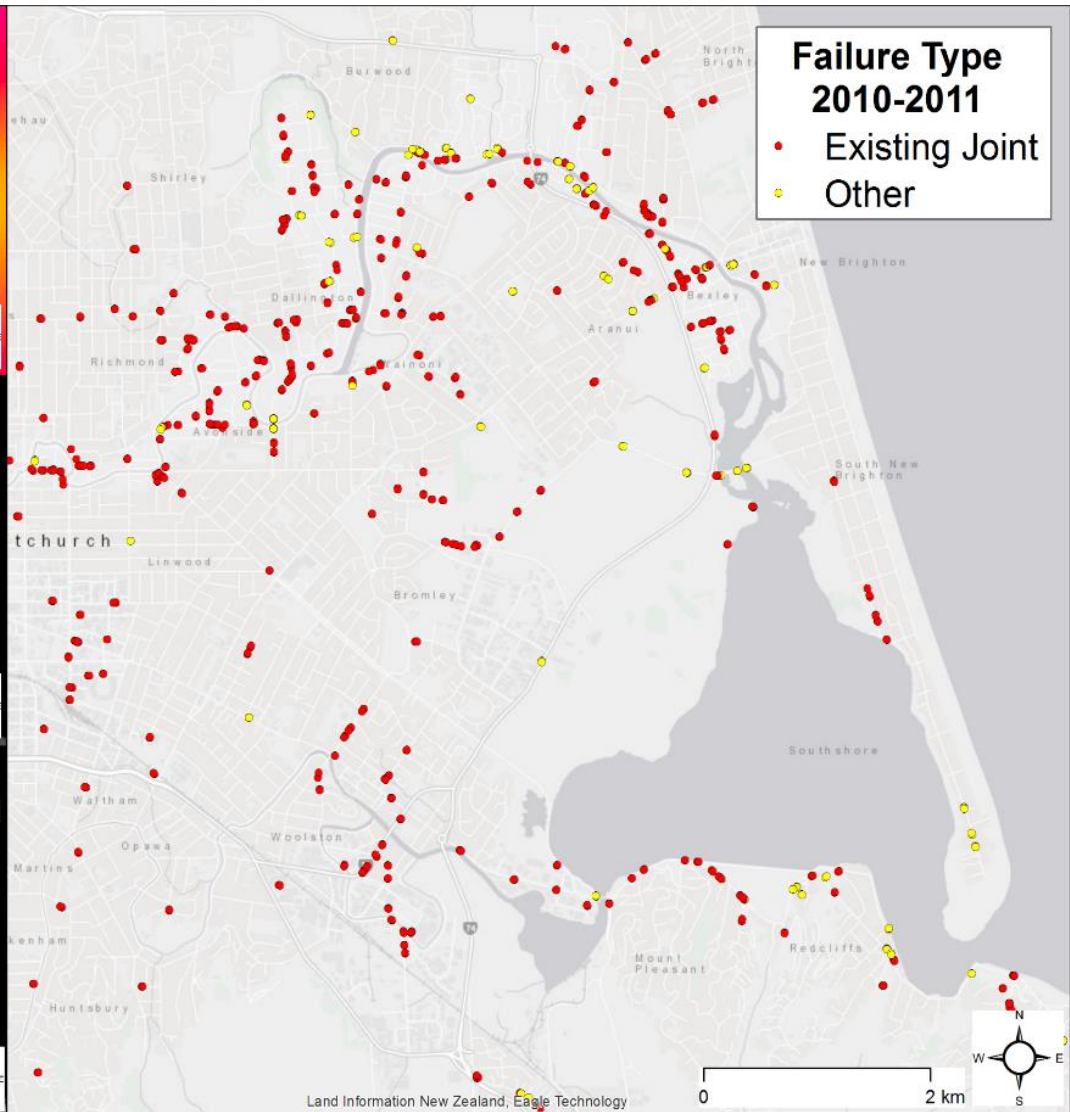
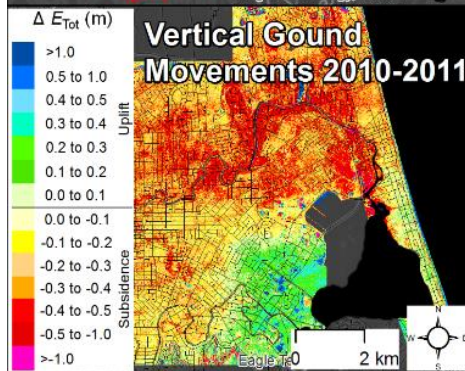
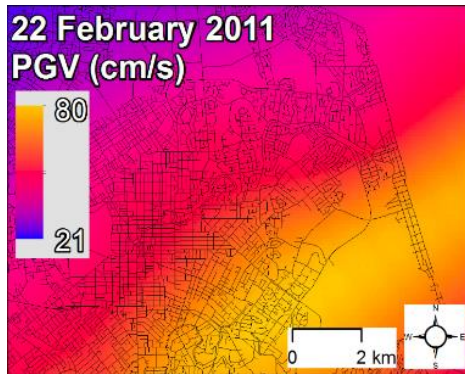
Electricity



Electricity

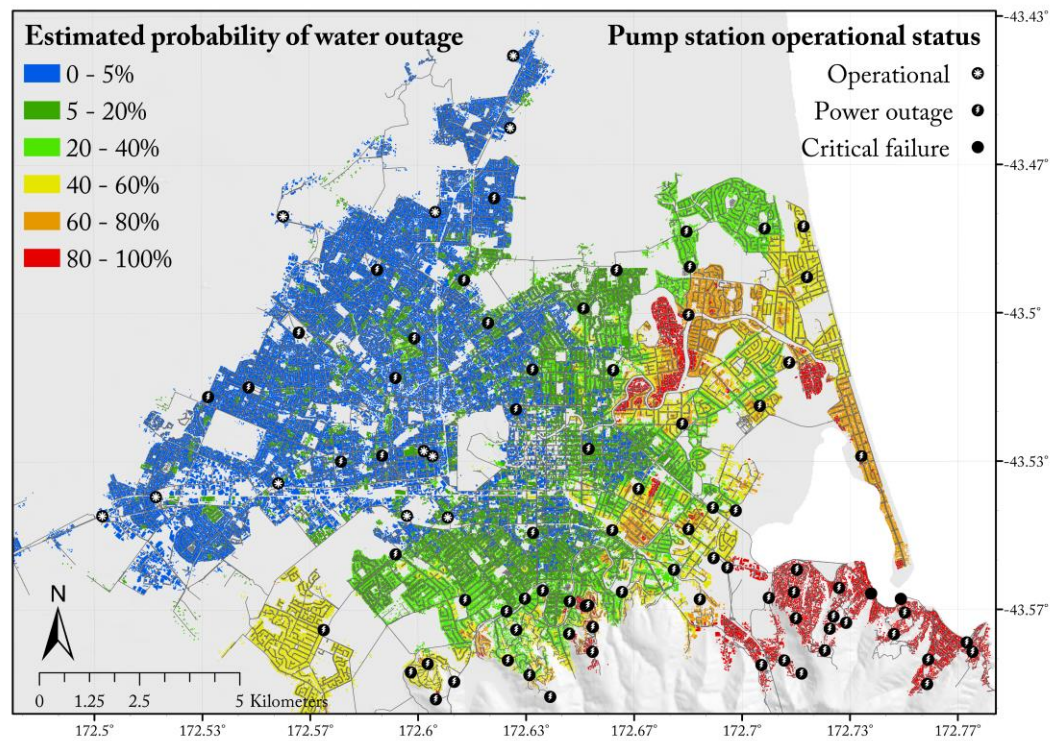
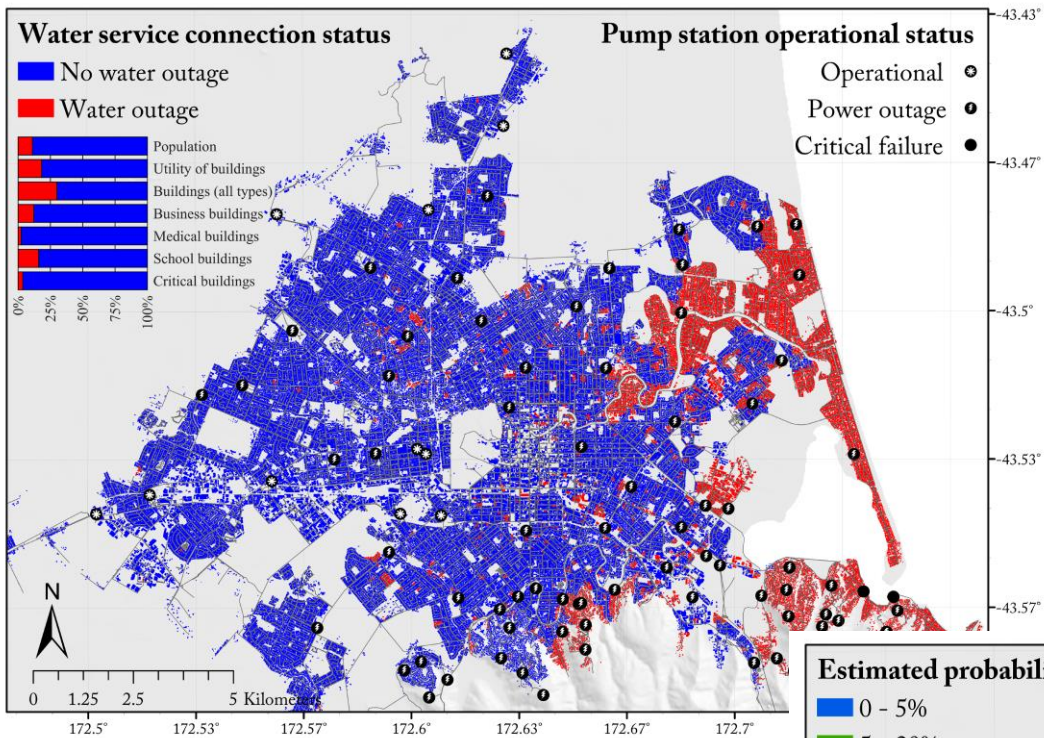
- Seismic fragility of buried HV cables (with Orion) End 2019
 - Development of performance dataset from Canterbury earthquake sequence
- Electric power criticality and resilience (EEA) Mid 2019
 - Build on Transport and other frameworks
- Tsunami impacts (Orion) End 2019
 - Component fragility modelling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

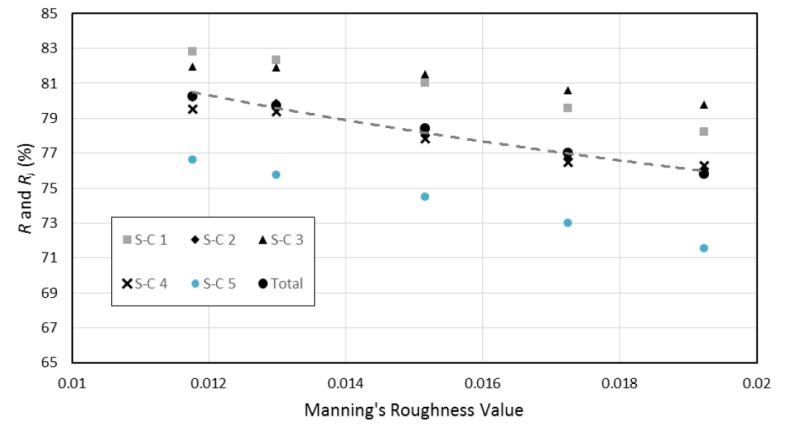
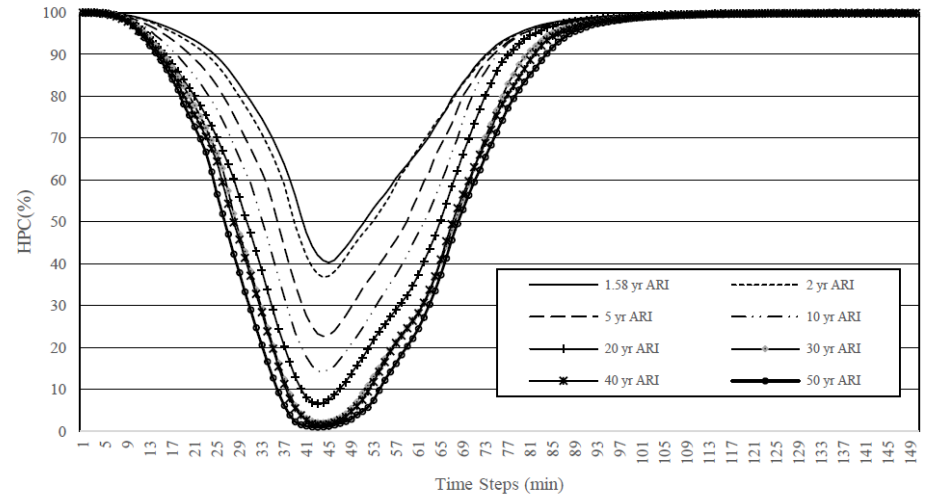
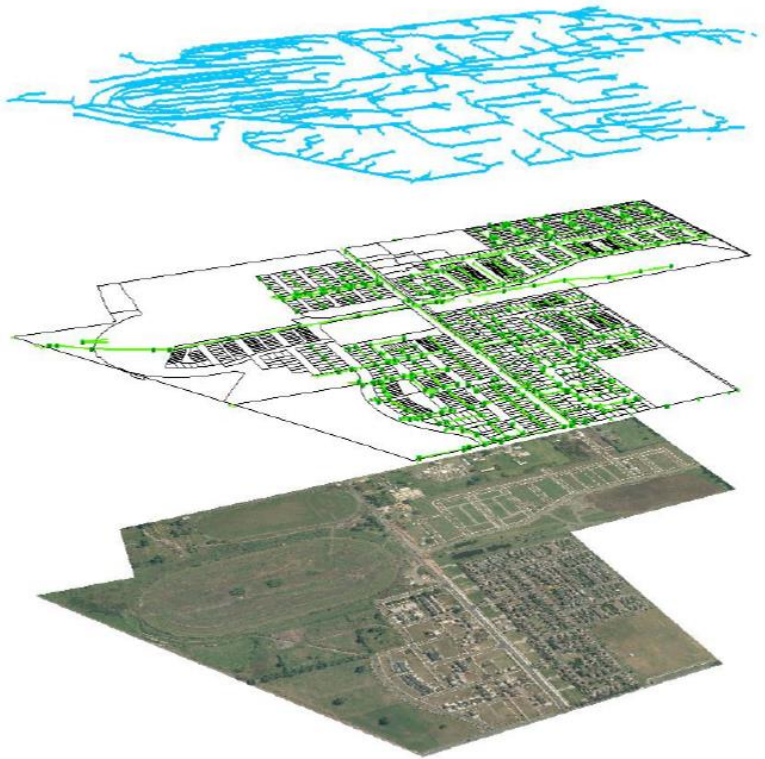
Electricity



3 Waters

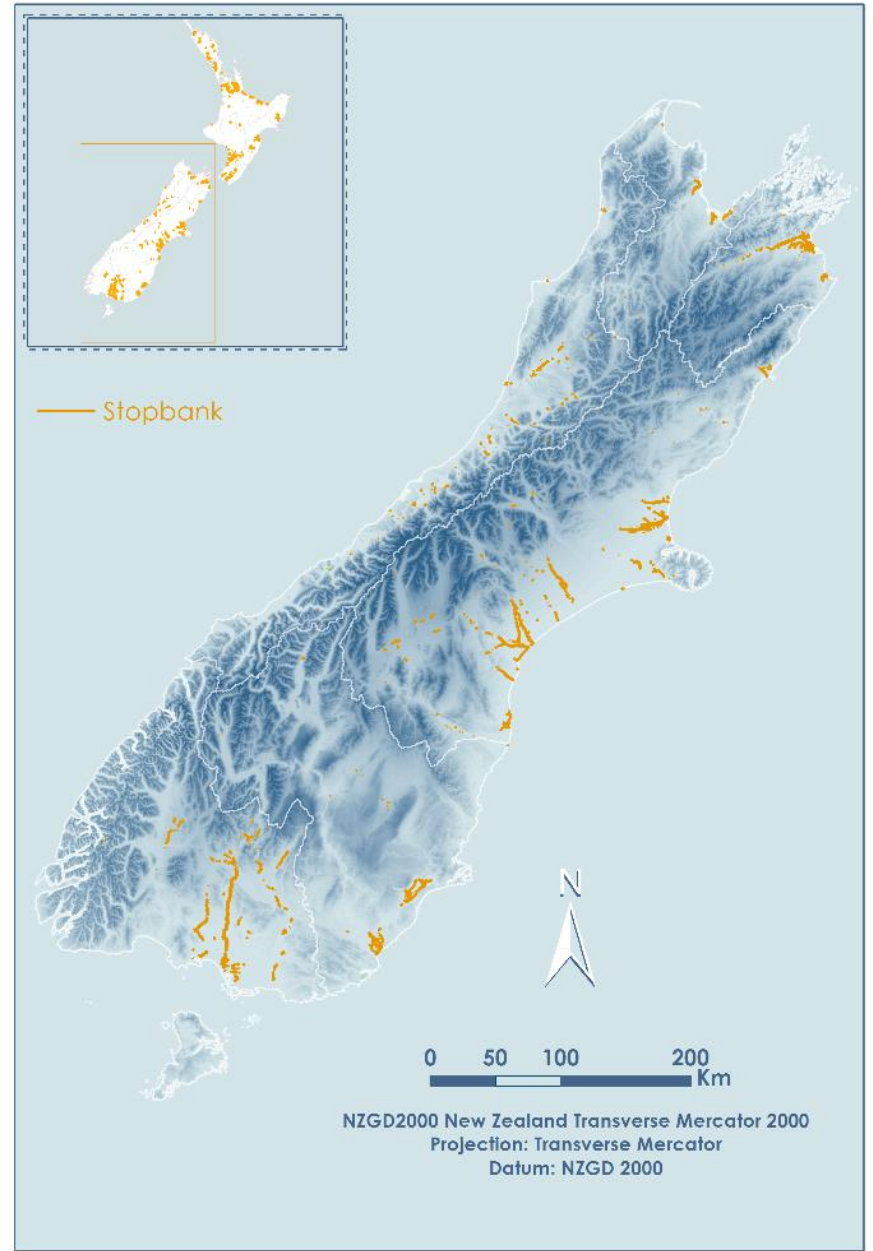
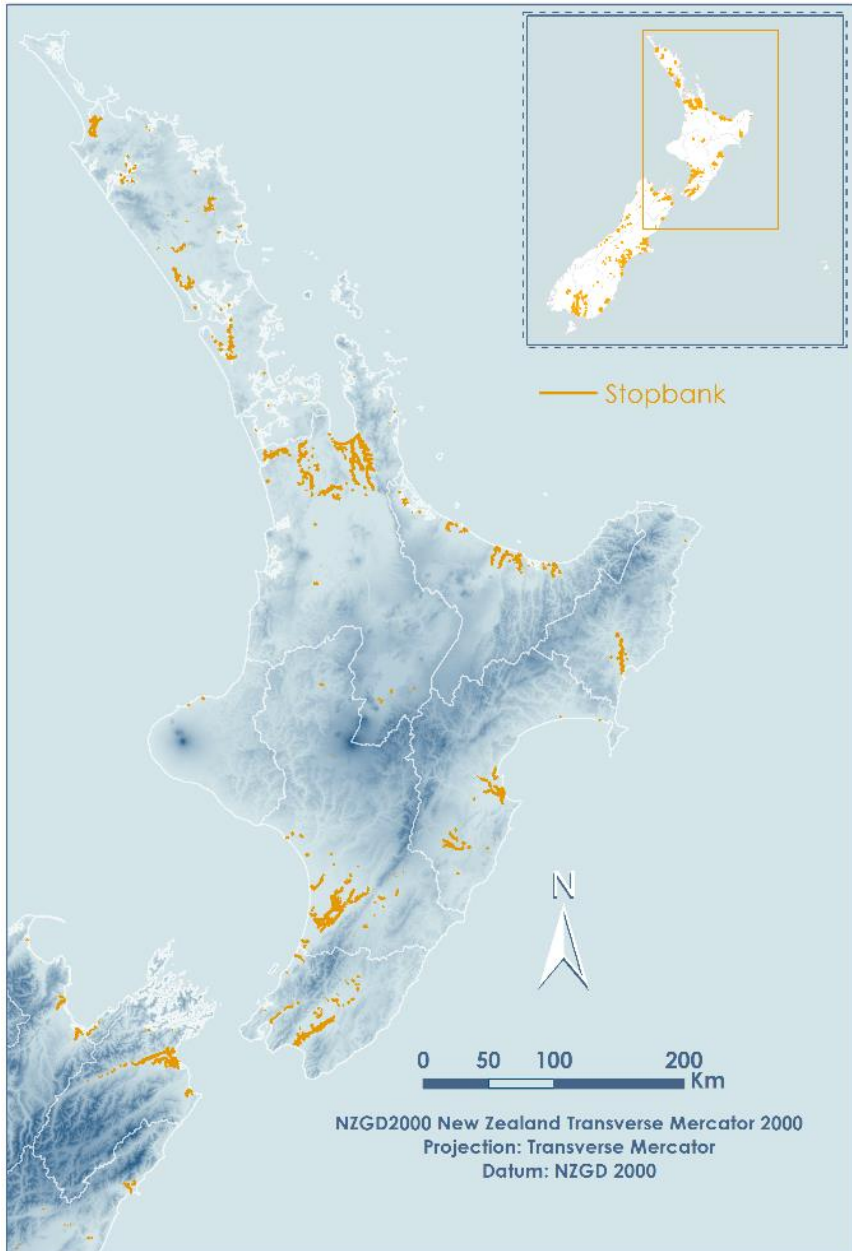
- Potable water (with CCC)
 - Development of seismic fragility models from Canterbury earthquake sequence dataset **COMPLETE**
 - Development of system recovery tool for Christchurch network **COMPLETE**
- Wastewater (with CCC)
 - Dataset collation from Canterbury earthquake sequence **COMPLETE**
- Stormwater 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 **COMPLETE**
 - Stopbank failure mode modelling **2020**



Telecommunications

- Telecommunications performance in Canterbury and Kaikōura EQs (Chorus)

End 2019

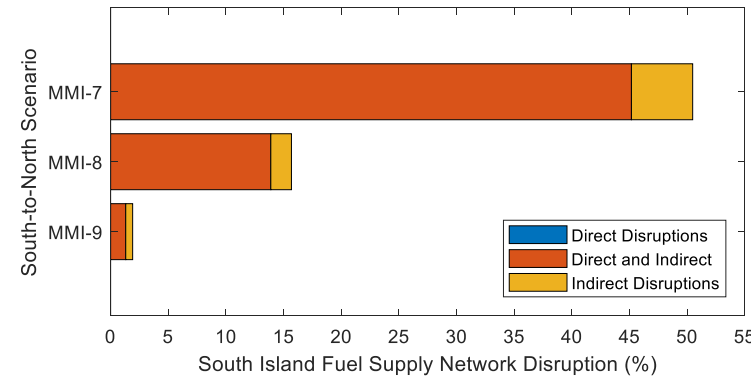
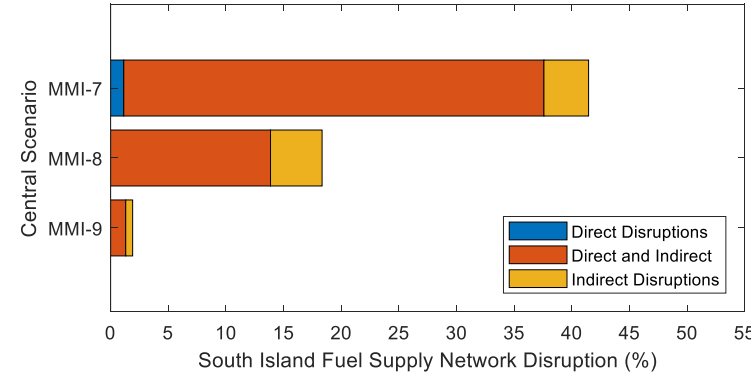
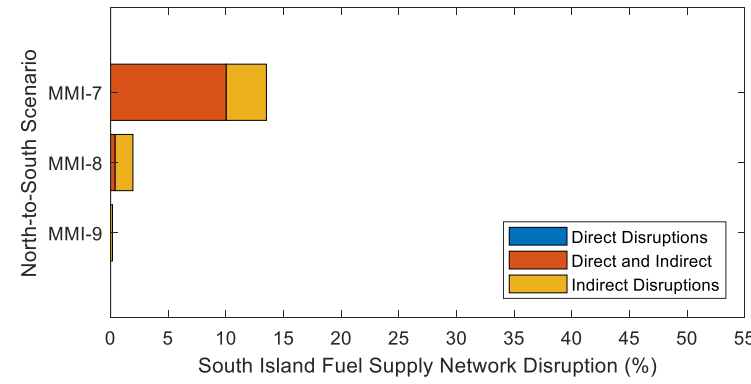
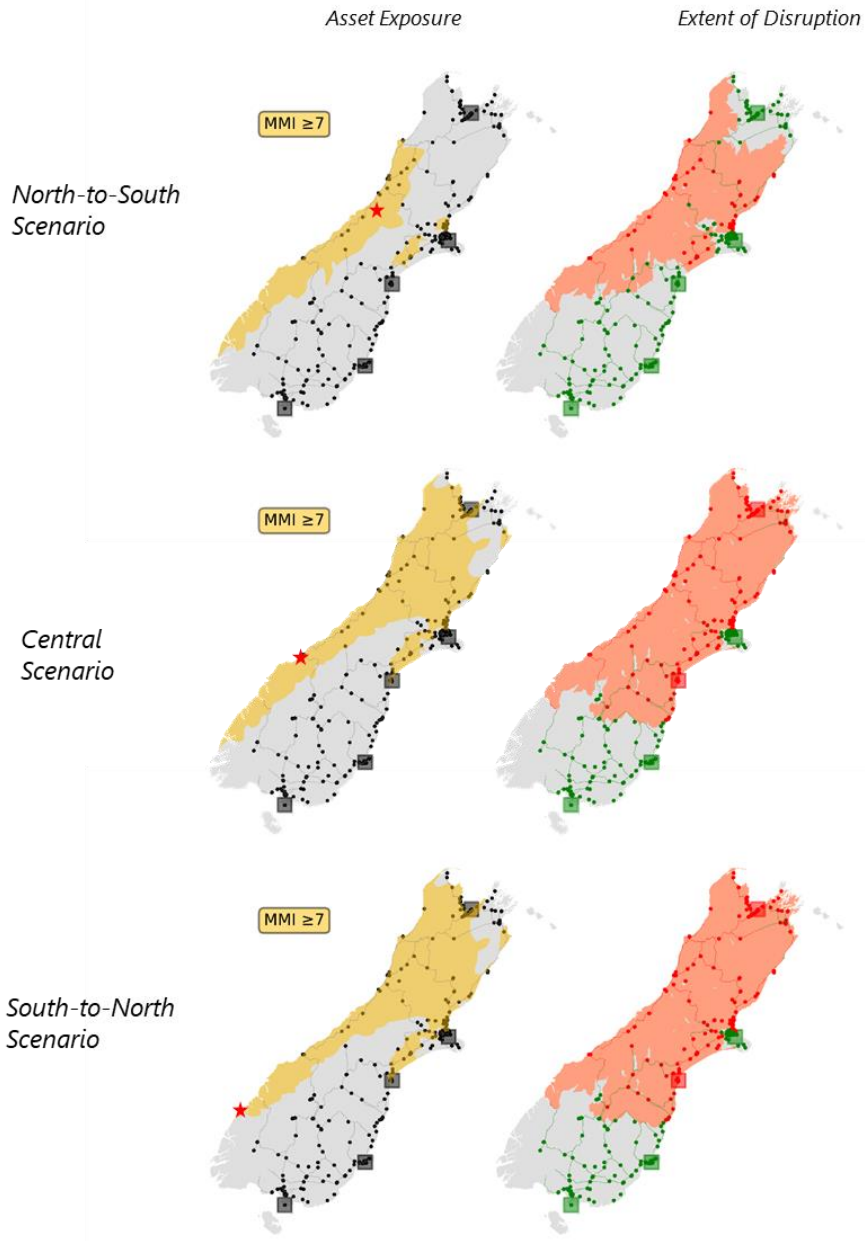
- Electricity-communication resilience through AF scenario

Mid 2020

End-to-End Simulation

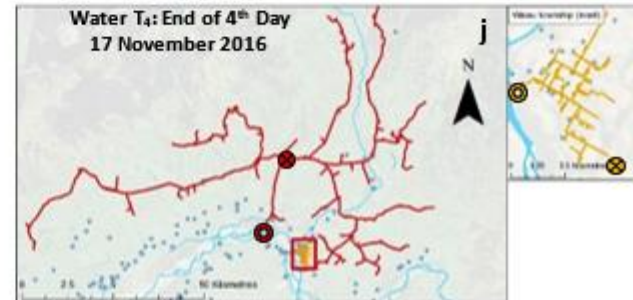
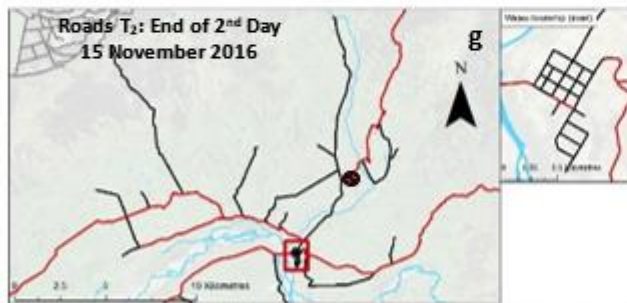
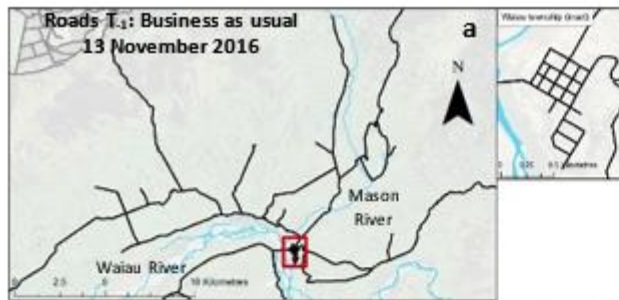
- National Scale Interdependent Infrastructure Model
COMPLETE
- Incorporation of electric power network process models into interdependency models
End 2019
- Linkage of model outputs into MERIT
Test Case – Corridor Forums
- End-to-end impact assessment framework
COMPLETE

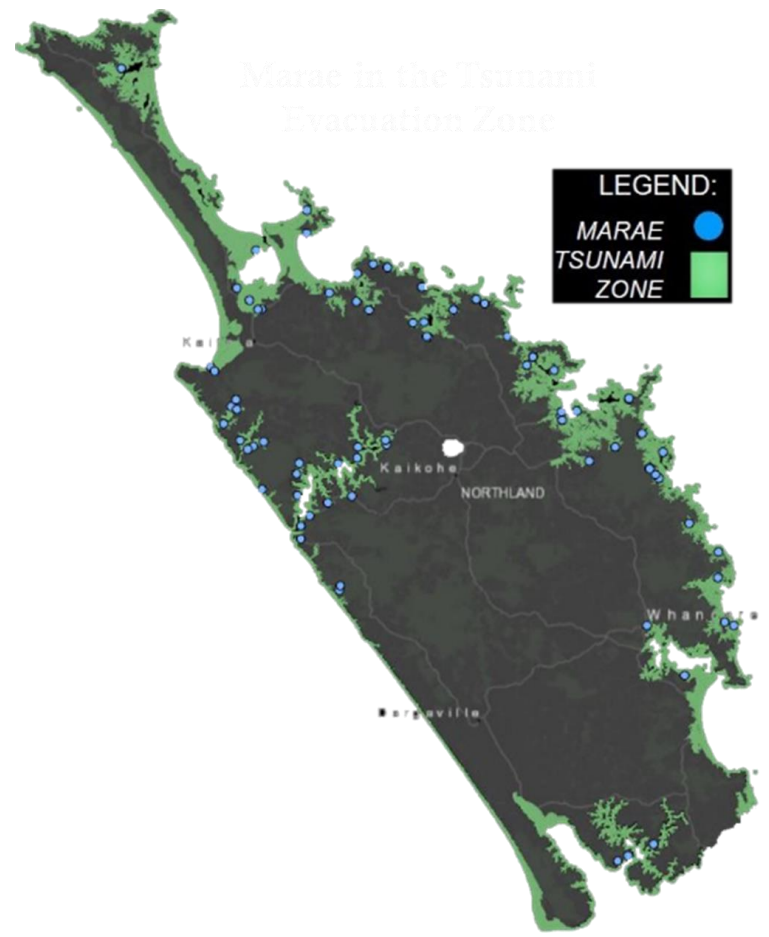
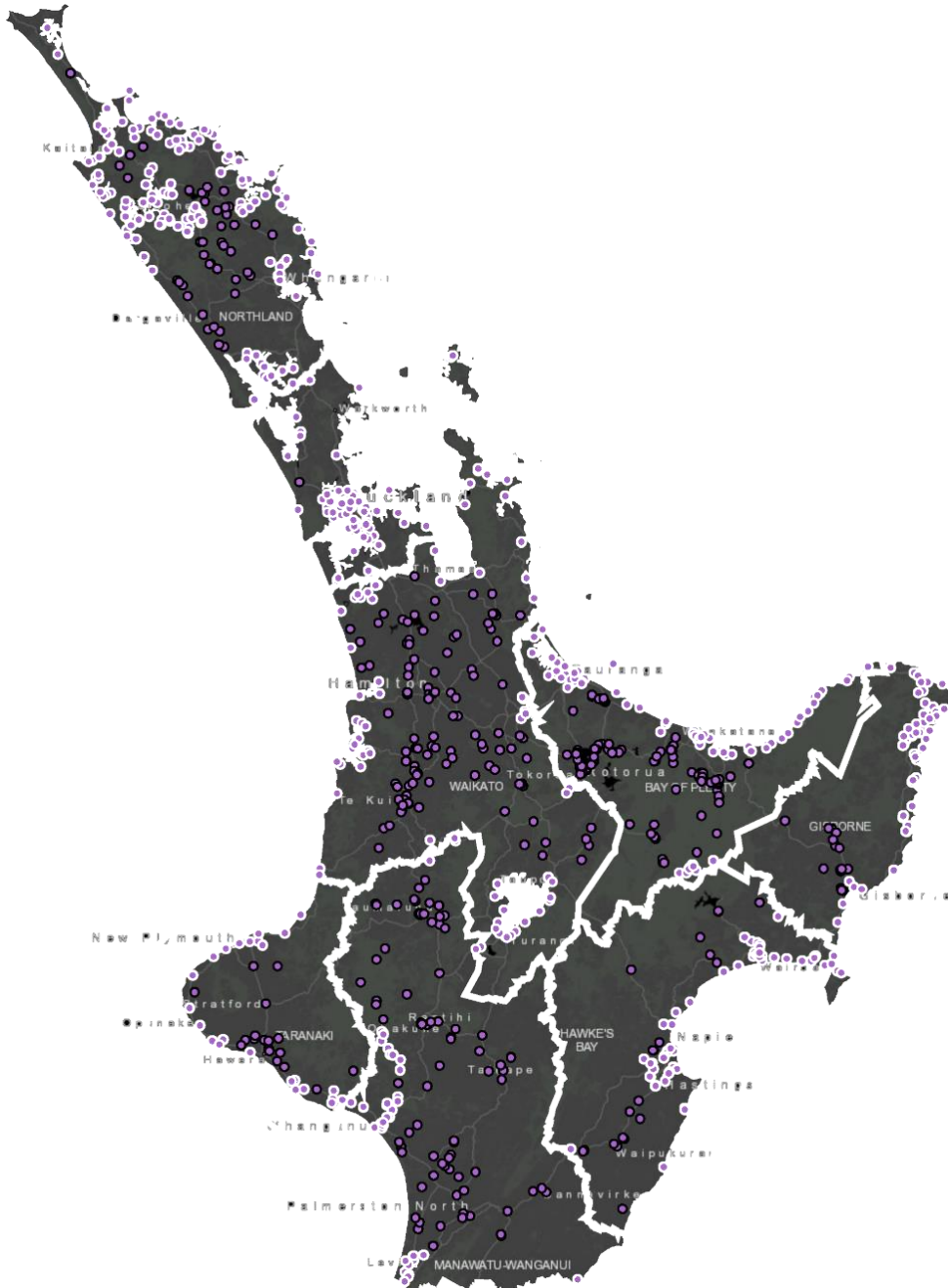
Alpine Fault Scenarios



Society and Behaviour

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





Marae in the Tsunami Evacuation Zone

LEGEND:

- MARAe ●
- TSUNAMI ZONE ■