End-to-end modelling of disruption events

Cascading hazards, interdependencies, resilience mitigation & adaptation

Define Event	Intensity	Exposure	Fragility	Impact	Restoration	Outage	Multi-capital Impacts	Iterative
What, where, size	PGA, Sa(x), MMI, LSN…	People Buildings, Infras-tructure …	How hazards damage assets	Deaths, Dollars, Downtime	Asset recovery	Outage maps	Economic Social Environ-mental	Solutions

Hazard | Damage | Disruption | Impacts

Cascading, co-incident | People, Buildings, Infrastructure | Response, Recovery Rebuild | Spatial & temporal for multiple stakeholders

MERIT

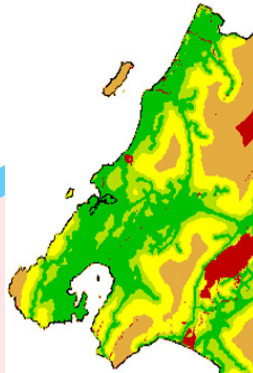ECONOMICS of RESILIENT INFRASTRUCTURE

m.e research

Resilient ORGANISATIONS

GNS SCIENCE TE PŪ AO

Measuring the Economics of Resilient Infrastructure Tool (MERIT)
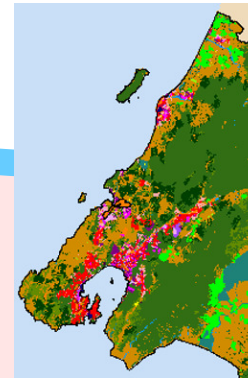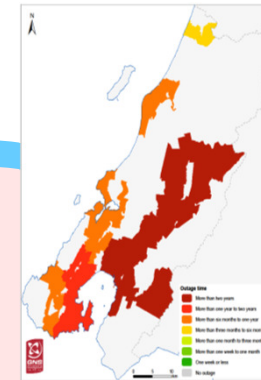
What's the modelling process?

MERIT
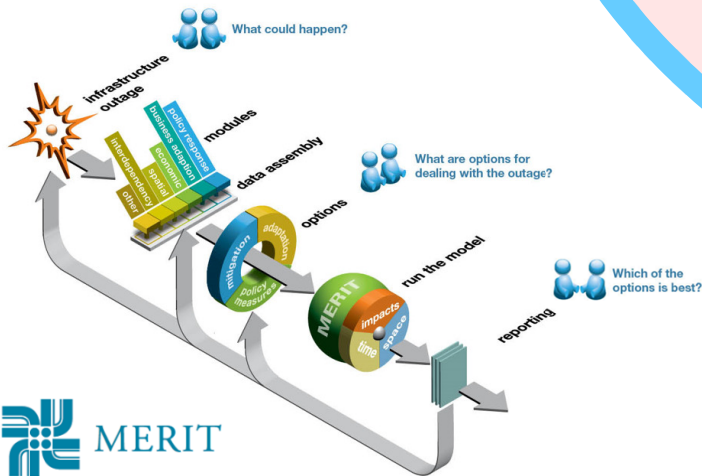
Direct Impacts on Tourism

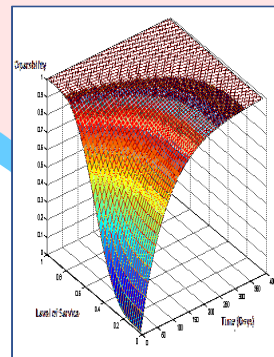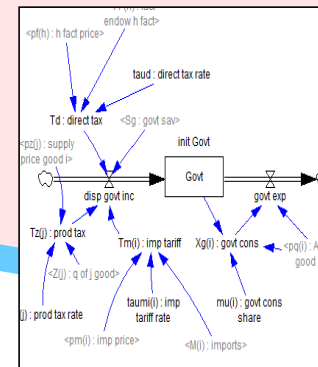**Direct Impacts on Transport – Fuel, Road, Rail, Water, Air, Ports**

Direct Impacts of People & Business Relocation

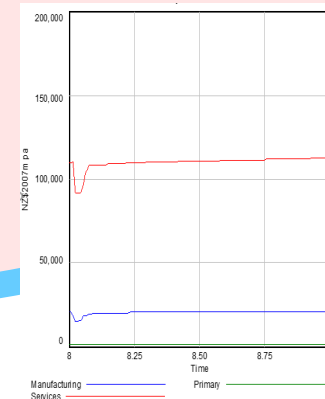**Hazard, Building Damage, Infrastructure Outage Maps**

What's Included?

Direct Impacts on Business Operation

Wider Economic Impacts using DEM

Net Results for Region, NZ – GDP, Income etc by industry

Science Impact & Excellence

Fuel Resilience - MBIE
Critical infrastructure failure

Economics of Disasters and climate change
June 2017, Volume 1, Issue 1, pp 111–120 | Cite as

Challenges and Opportunities for Economic Evaluation of Disaster Risk Decisions

Authors
Nicola Smith, Charlotte Brown, Garry McDonald, Morag Ayers, Robert Kipp, Wendy Saunders

Bulletin of Volcanology
July 2017, 78:48 | Cite as

The spatial and temporal 'cost' of assessing economic impact, but spatial distribution of risk in Zealand

Authors
Garry W. McDonald, Nicola J. Smith, and affili

Bulletin of Volcanology
December 2017, 79:87 | Cite as

Computable general equilibrium modelling of economic impacts from volcanic event scenarios at regional and national scale, Mt. Taranaki, New Zealand

Authors
G. W. McDonald, S. J. Groth, N. J. Smith, C. A. Murray, J. H. Princer

**Cred...
18 Infrastr...**
Resilience planning
$2-3 billion of investment

Managed Retreat
Slow onset hazards

HAWKE'S BAY REGIONAL COUNCIL

**Volcanic Eruptions –
Councils and Lifelines**
Distributional impacts

Spatial MERIT
Inte...

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Computers, Environment and Urban Systems

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Developing integrated models by coupling together existing models, land use, economics, demographics and transport in Wellington, New Zealand

Emily P. Harvey[a], Robert C. Cardwell, Nicola J. Smith, Garry W. McDonald, Hedwig van Delden[b], Roel Vanhout[b], John Inван Kim[a], Vicky E. Forgie[a], Marjan van den Belt[e]

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Land use

Transport
Travel and freight cost

Transport MERIT
Network disruption

The economic impacts of road outages in New Zealand

Background and correct
About the model

Select outage region

North Island
Northland
Auckland
Waikato
Bay of Plenty
Gisborne
Hawke's Bay
Taranaki
Manawatu Wanganui
Wellington

South Island
Nelson-Tasman
Marlborough
West Coast
Canterbury
Otago
Southland

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NZ TRANSPORT AGENCY
WAKA KOTAHI

**Alpine Fault –
Councils and Lifelines**
Event impacts

ALPINE MAGN...

Journal

Civil Engineering and Environmental Systems >

Economic Systems Modelling of Infrastructure Interdependencies for an Alpine Fault Earthquake in New Zealand

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HIKINA WHAKATUTUKI

The impact of the 2016 Kaikoura earthquake on our economy

Ministry of Transport
Te Manatū Waka
Enabling New Zealanders to flourish

Kaikōura Earthquake
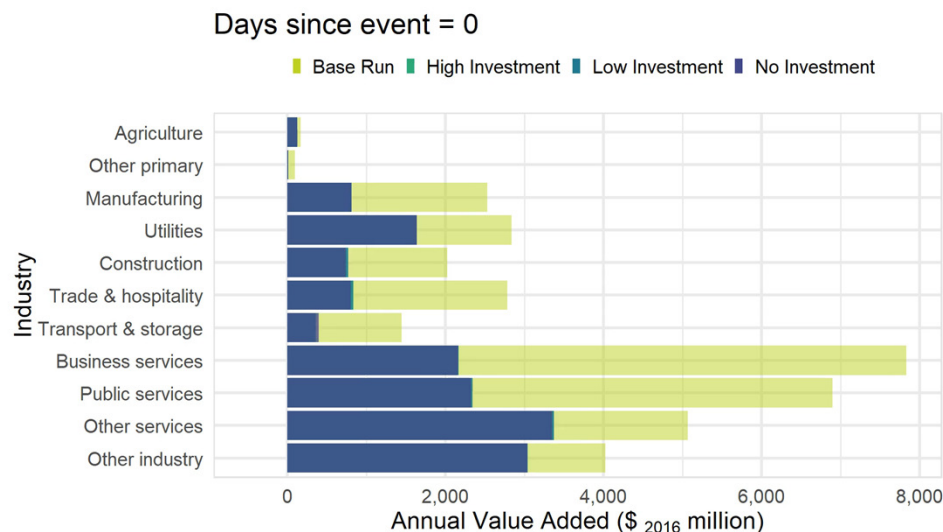Agile event response
Recovery planning

Where is MERIT being applied?

- Single infrastructure disruptions
  - Electricity (Vector, Transpower)
  - Port (Lyttelton), Road (MoT, NZTA)
  - Water (WaterCare, Wellington Water)
- Natural hazard event disruptions
  - Alpine Fault (MCDEM)
  - Auckland Volcanic Field (AC, AELG)
  - Kaikōura (MoT/MBIE/NZTA)
  - Wellington Fault (GW, WELG, etc)
- Business Cases
  - Wellington Resilience Project – 18 infrastructure providers, 2-3 billion of investment
- Developed under MBIE funding, QuakeCoRE, Resilience NSC and through commercial contracts

➤ For more information   https://www.merit.org.nz/

Days since event = 0

■ Base Run ■ High Investment ■ Low Investment ■ No Investment