AF8
ALPINE FAULT MAGNITUDE 8

# Building response capability and readiness for a future magnitude 8 Alpine Fault earthquake

Tuesday 8th October, Wellington

**Caroline Orchiston// Science Lead AF8, Deputy Director Centre for Sustainability, University of Otago**

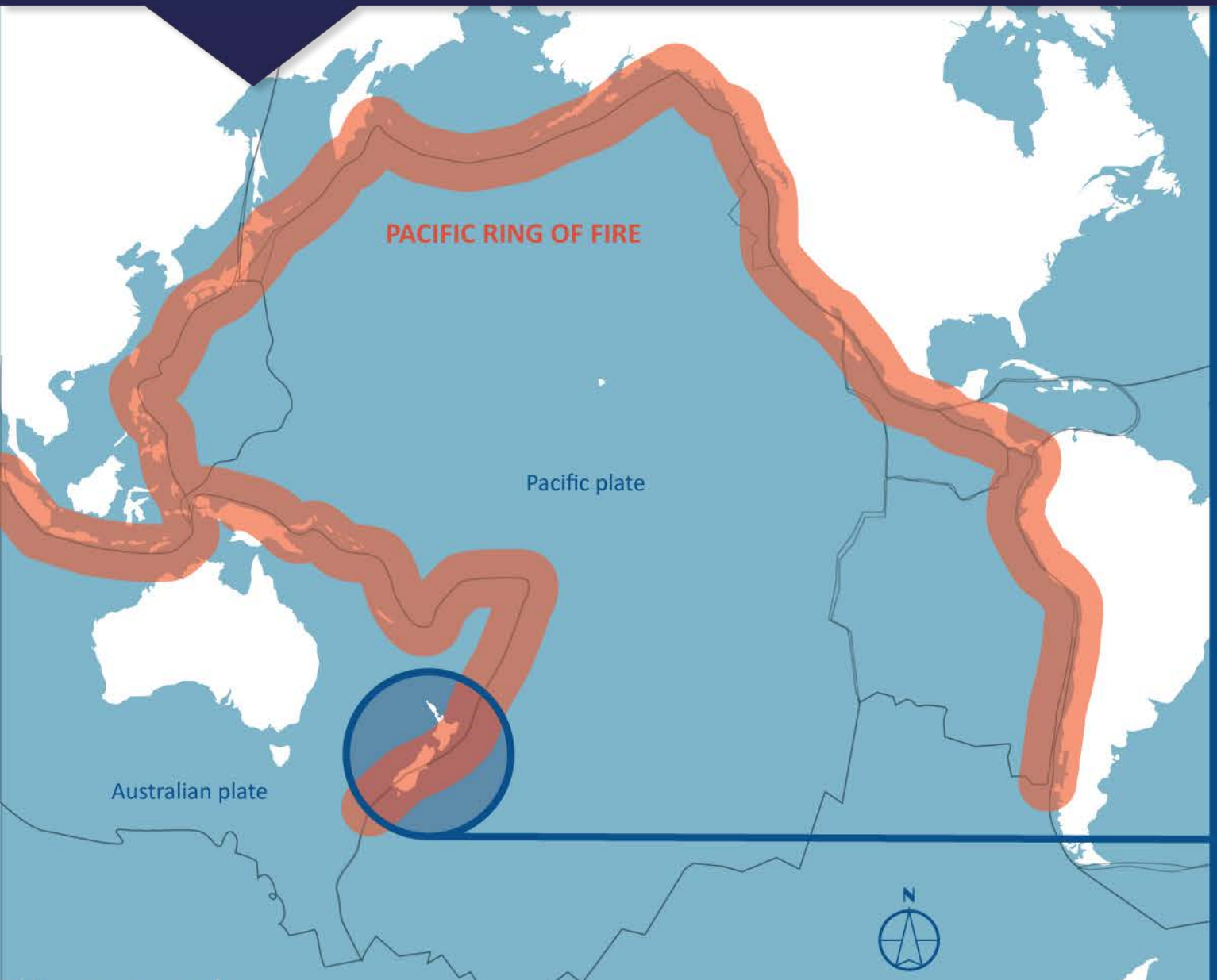
Ministry of Civil Defence & Emergency Management
Te Rākau Whakamarumaru

QuakeCoRE
NZ Centre for Earthquake Resilience
*Te Hiranga Rū*

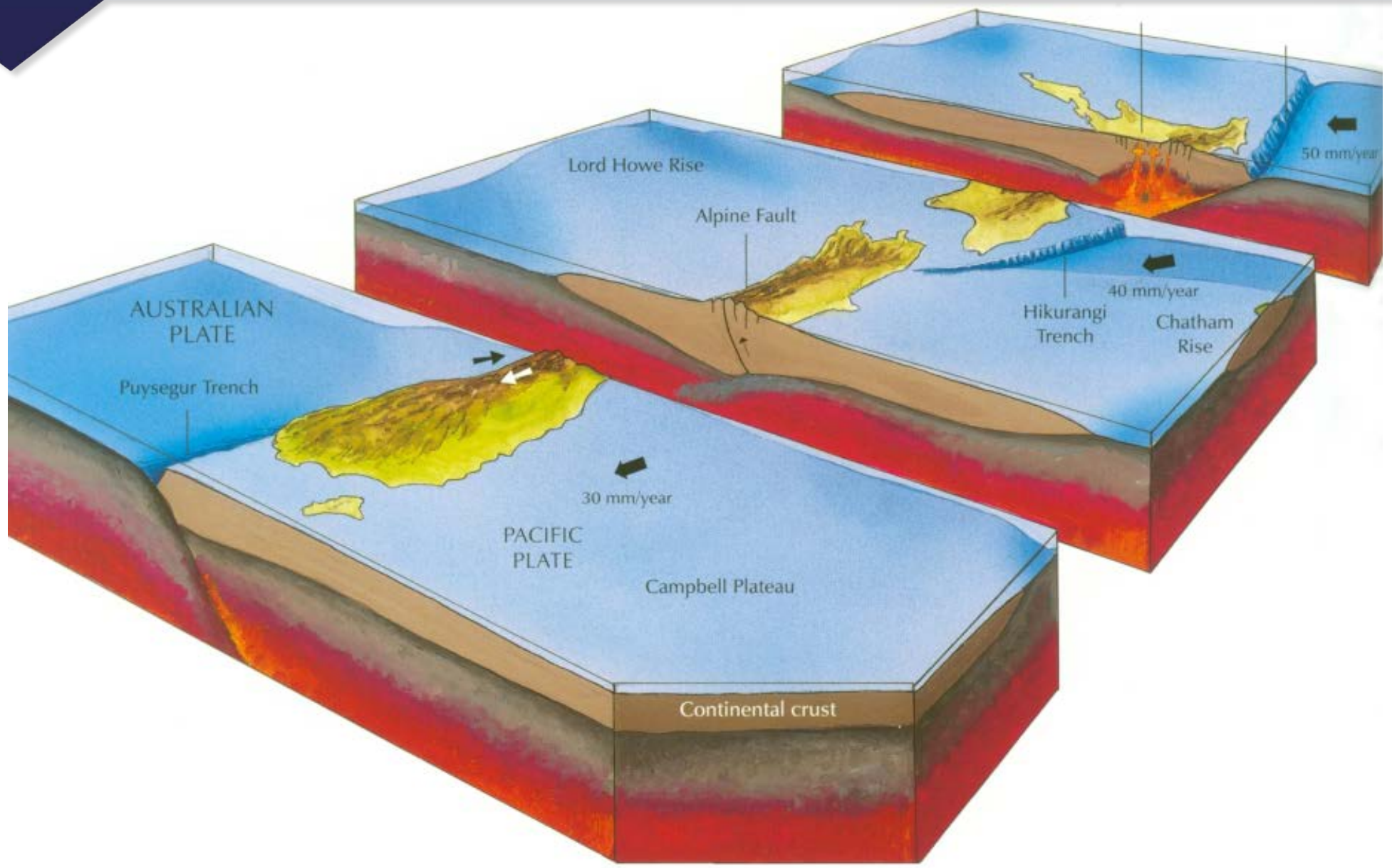
RESILIENCE TO NATURE'S CHALLENGES
Kia manawaroa – Ngā Ākina o Te Ao Tūroa

National SCIENCE Challenges

# Tectonic setting of NZ




# Tectonic setting of NZ



Harold Wellman

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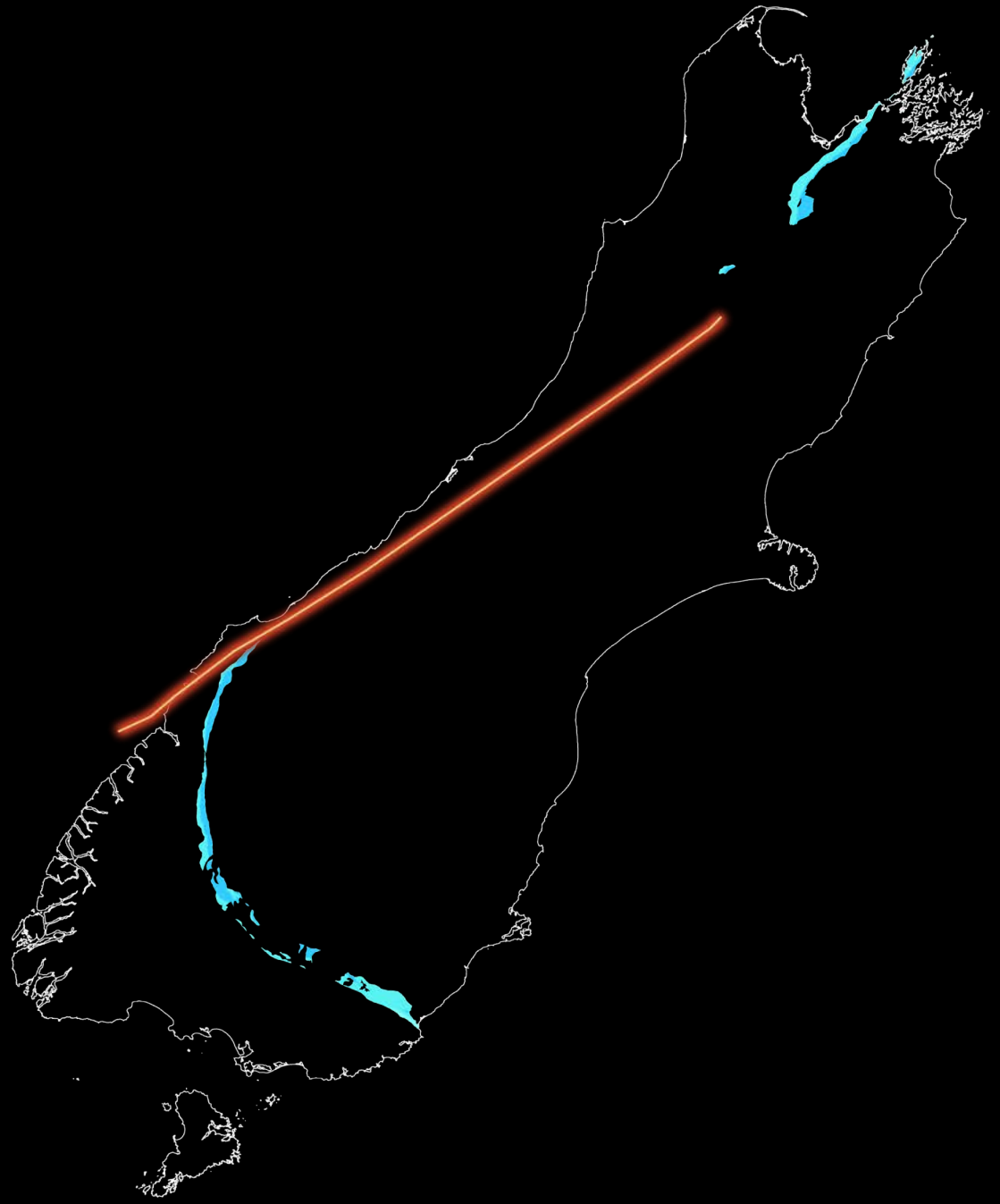
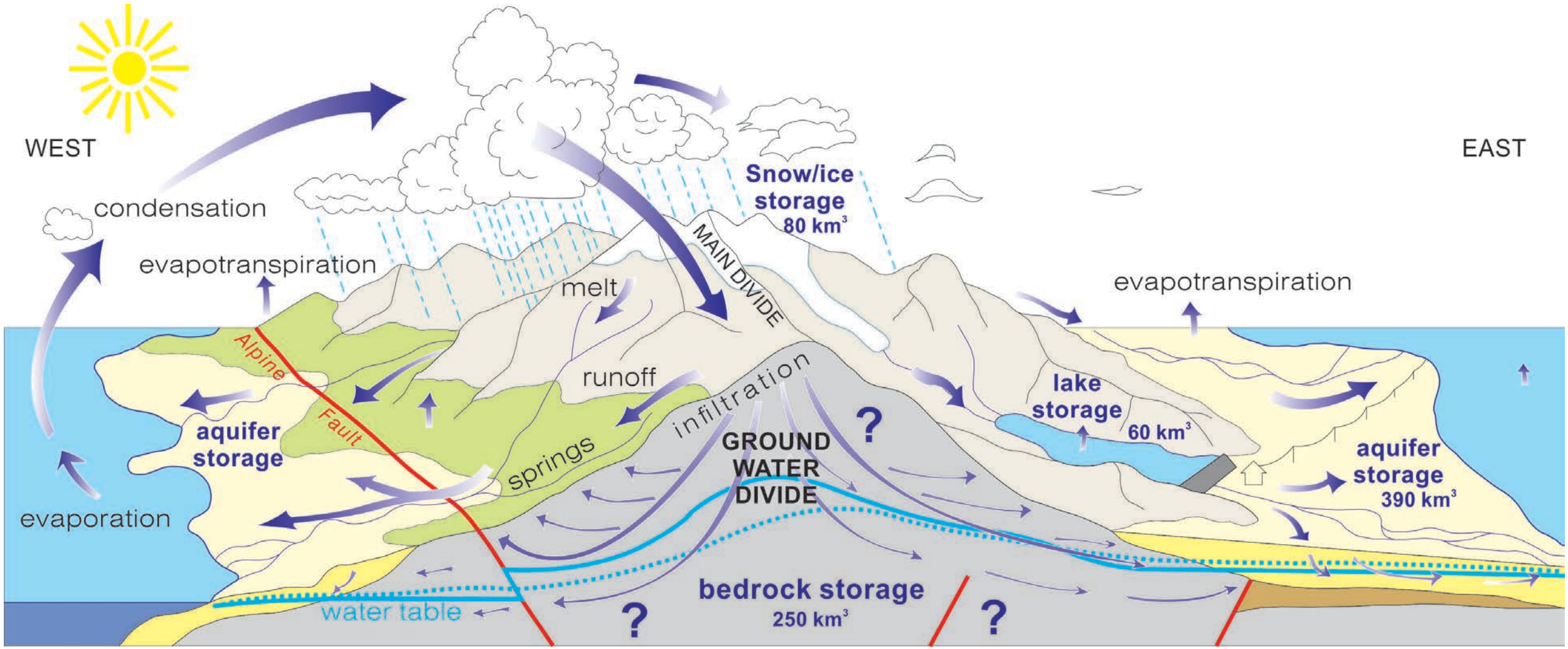


Harold Wellman


Waimakariri River
Alpine Fault
Rakaia River

# Geological and climatic coupling

Slide courtesy of Dr. Simon Cox, GNS Science



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# BUILDING OUR COLLECTIVE RESILIENCE

# What is AF8?

- A programme of scientific modelling, response planning and community engagement.
- Particular focus on impacts on South Island communities.
- Building our collective resilience to future events

# What is AF8?

- Year 1-2 focus: to co-create a collaborative response framework (SAFER Framework)
- Year 3 focus: to outreach and engage widely (Roadshow)
- Year 4 focus: Response, Engagement, Risk Communication and Recovery

# What is AF8?

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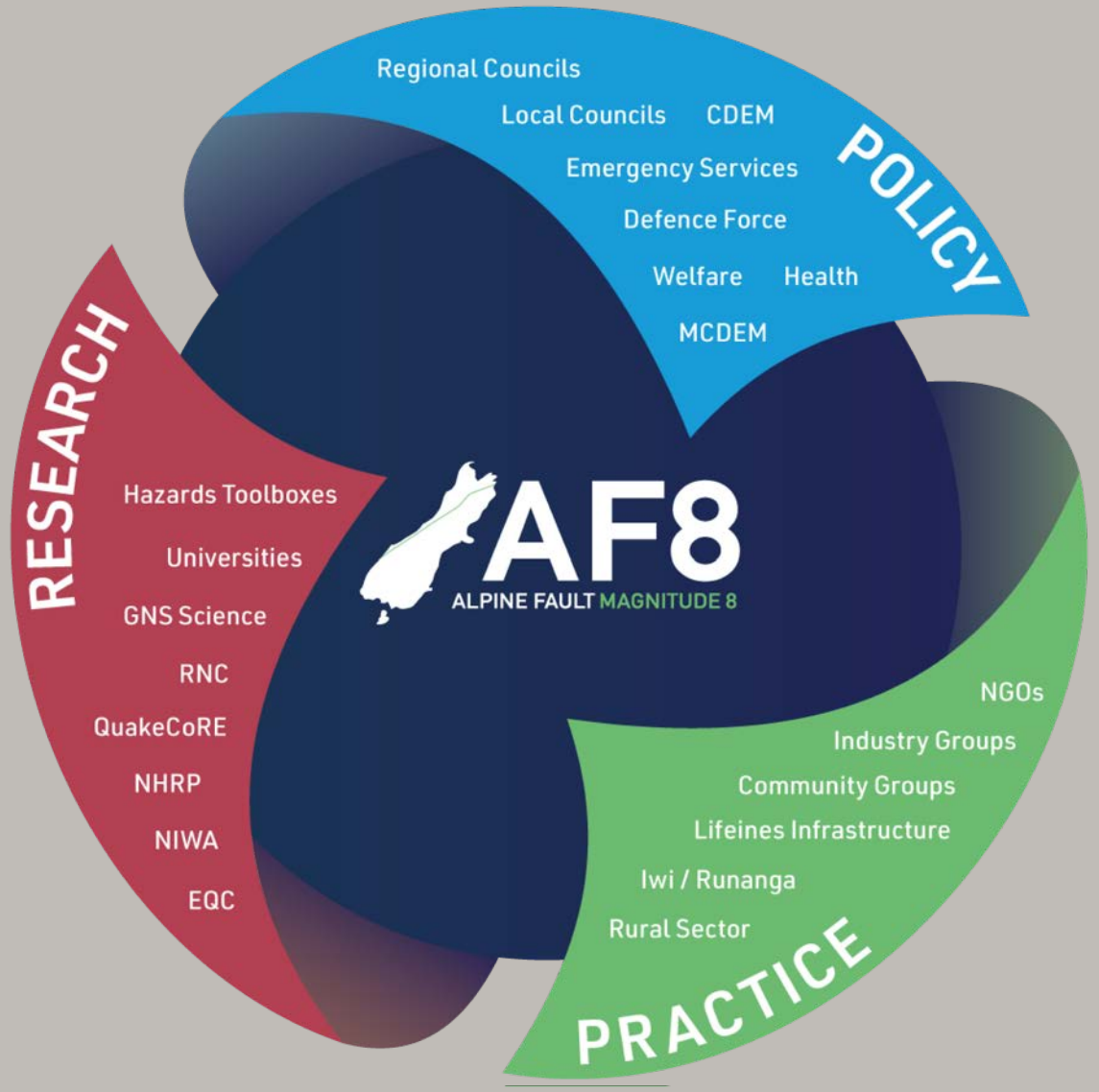
**RESEARCH**

**POLICY**

**PRACTICE**



# Response Framework

## RISK TEAM

- 30+ Researchers
- 6 Universities
- 2 Consulting firms

## RESPONSE TEAM

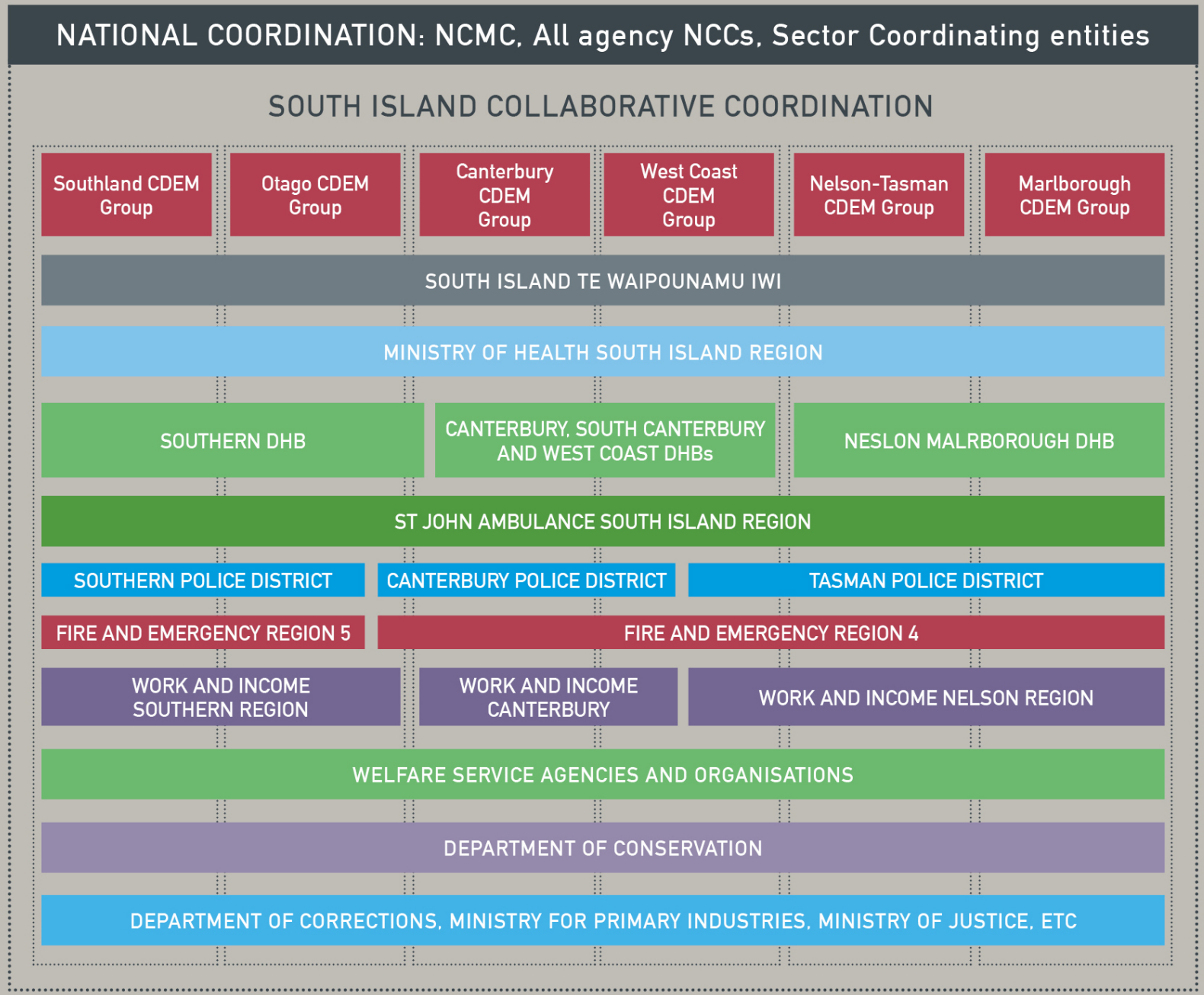
- 6 CDEM groups
- Project AF8 Project Manager
- Ministry of Civil Defence Emergency Management

# Response Framework

**South Island Alpine Fault Earthquake Response Framework**

**Available for download from the AF8 website:**

**www.af8.org.nz**



NATIONAL COORDINATION: NCMC, All agency NCCs, Sector Coordinating entities
SOUTH ISLAND COLLABORATIVE COORDINATION
Southland CDEM Group
Otago CDEM Group
Canterbury CDEM Group
West Coast CDEM Group
Nelson-Tasman CDEM Group
Marlborough CDEM Group
SOUTH ISLAND TE WAIPOUNAMU IWI
MINISTRY OF HEALTH SOUTH ISLAND REGION
SOUTHERN DHB
CANTERBURY, SOUTH CANTERBURY AND WEST COAST DHBs
NESLON MALRBOROUGH DHB
ST JOHN AMBULANCE SOUTH ISLAND REGION
SOUTHERN POLICE DISTRICT
CANTERBURY POLICE DISTRICT
TASMAN POLICE DISTRICT
FIRE AND EMERGENCY REGION 5
FIRE AND EMERGENCY REGION 4
WORK AND INCOME SOUTHERN REGION
WORK AND INCOME CANTERBURY
WORK AND INCOME NELSON REGION
WELFARE SERVICE AGENCIES AND ORGANISATIONS
DEPARTMENT OF CONSERVATION
DEPARTMENT OF CORRECTIONS, MINISTRY FOR PRIMARY INDUSTRIES, MINISTRY OF JUSTICE, ETC

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# What will an Alpine Fault earthquake be like?

# Alpine Fault hazard-risk-impact

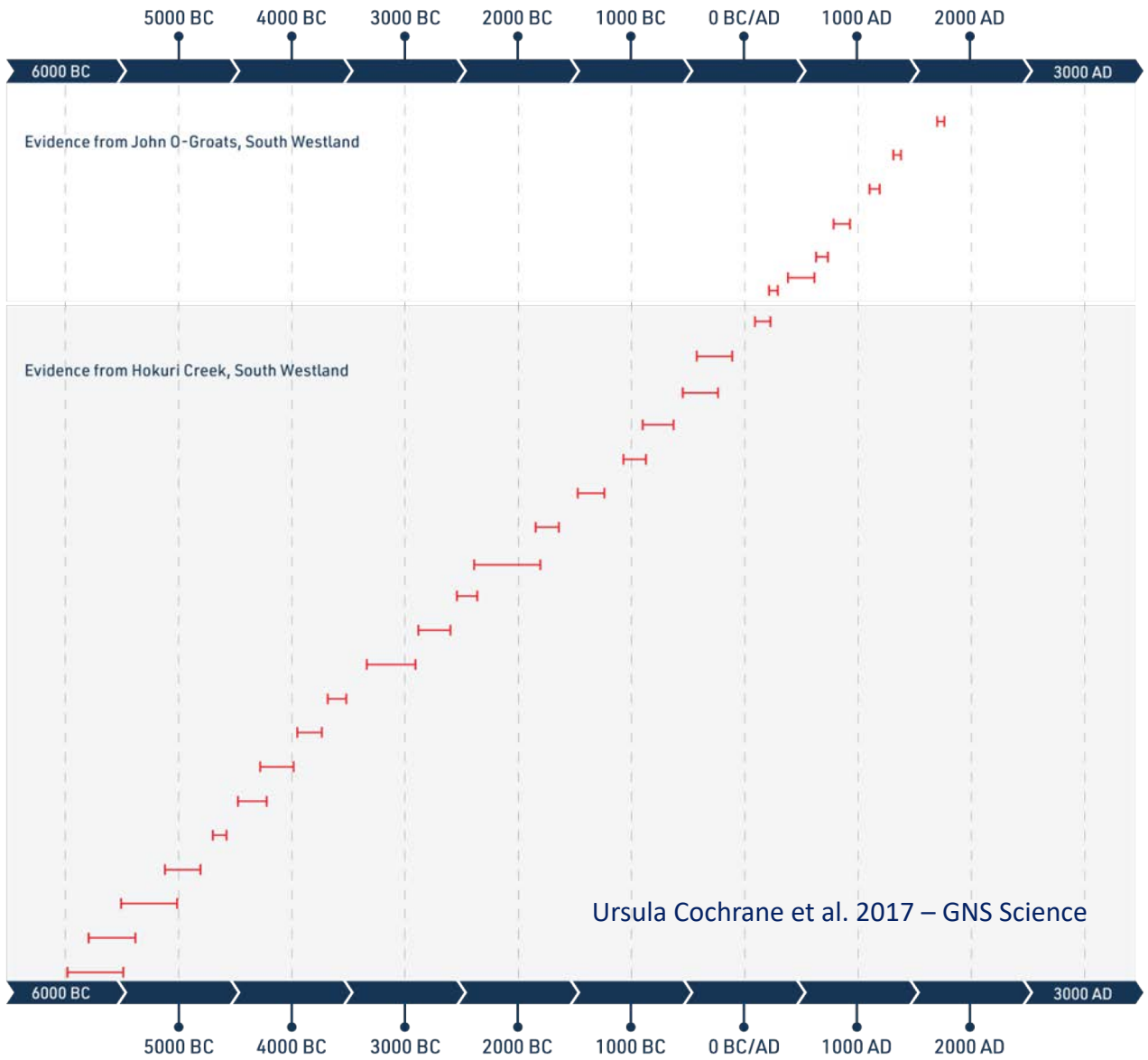
- **Frequency** – when is the next event likely to occur? (probability)
- **Magnitude** – how big?

- **Intensity** – how strong/long will the effects be?
- **Hazard footprint** – what area will be affected?

- **Impacts/Consequences?**
- **Risk reduction - infrastructure/community/societal resilience?**

# Frequency

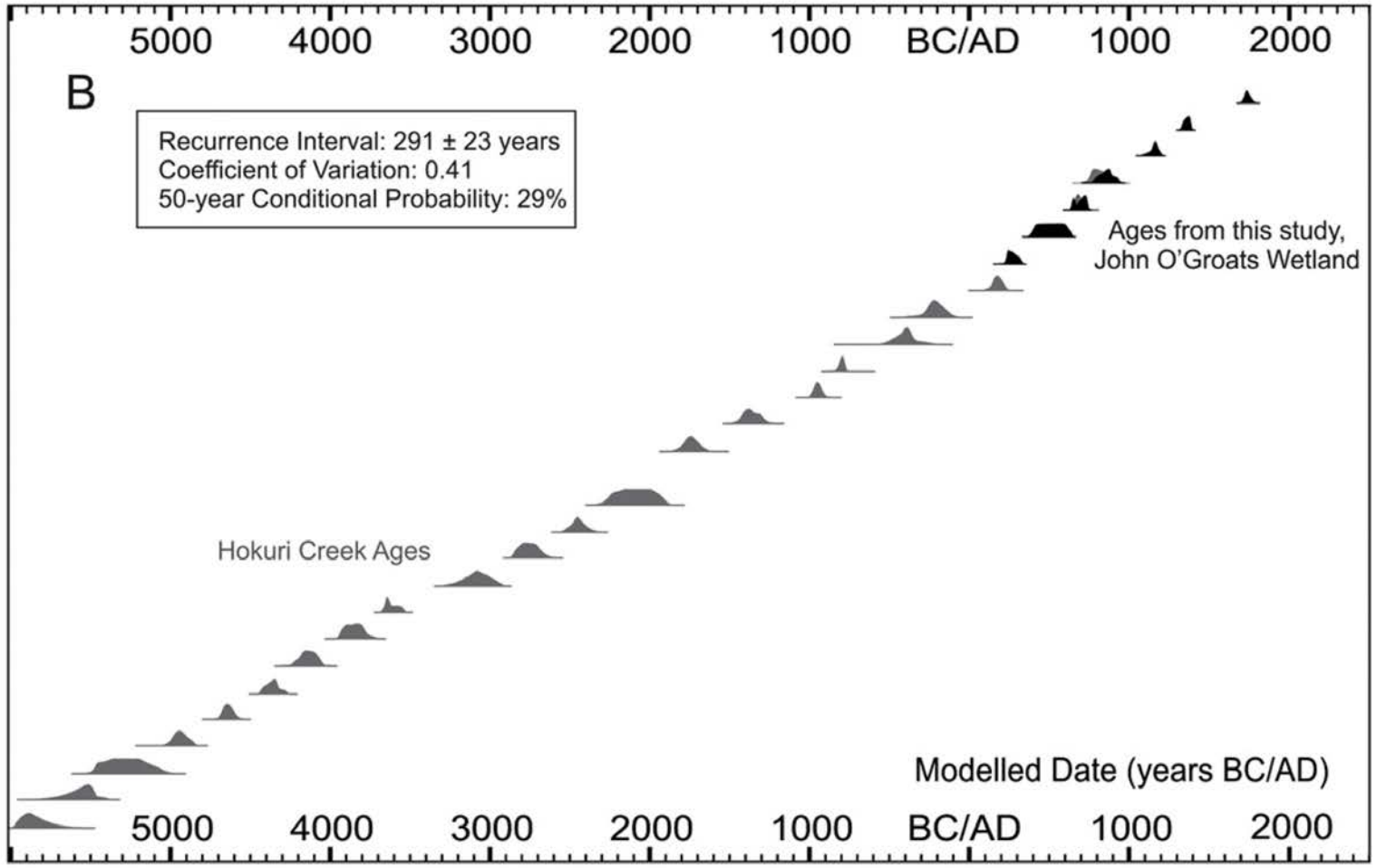
- Evidence of 27 earthquakes over the past 8,000 years
- Long history of large earthquakes
- Remarkably regular
- Mean recurrence interval of ~300 years
- Last significant earthquake was 1717AD
- The next one is inevitable



# Frequency

## Frequency – when is the next event(s) going to occur?

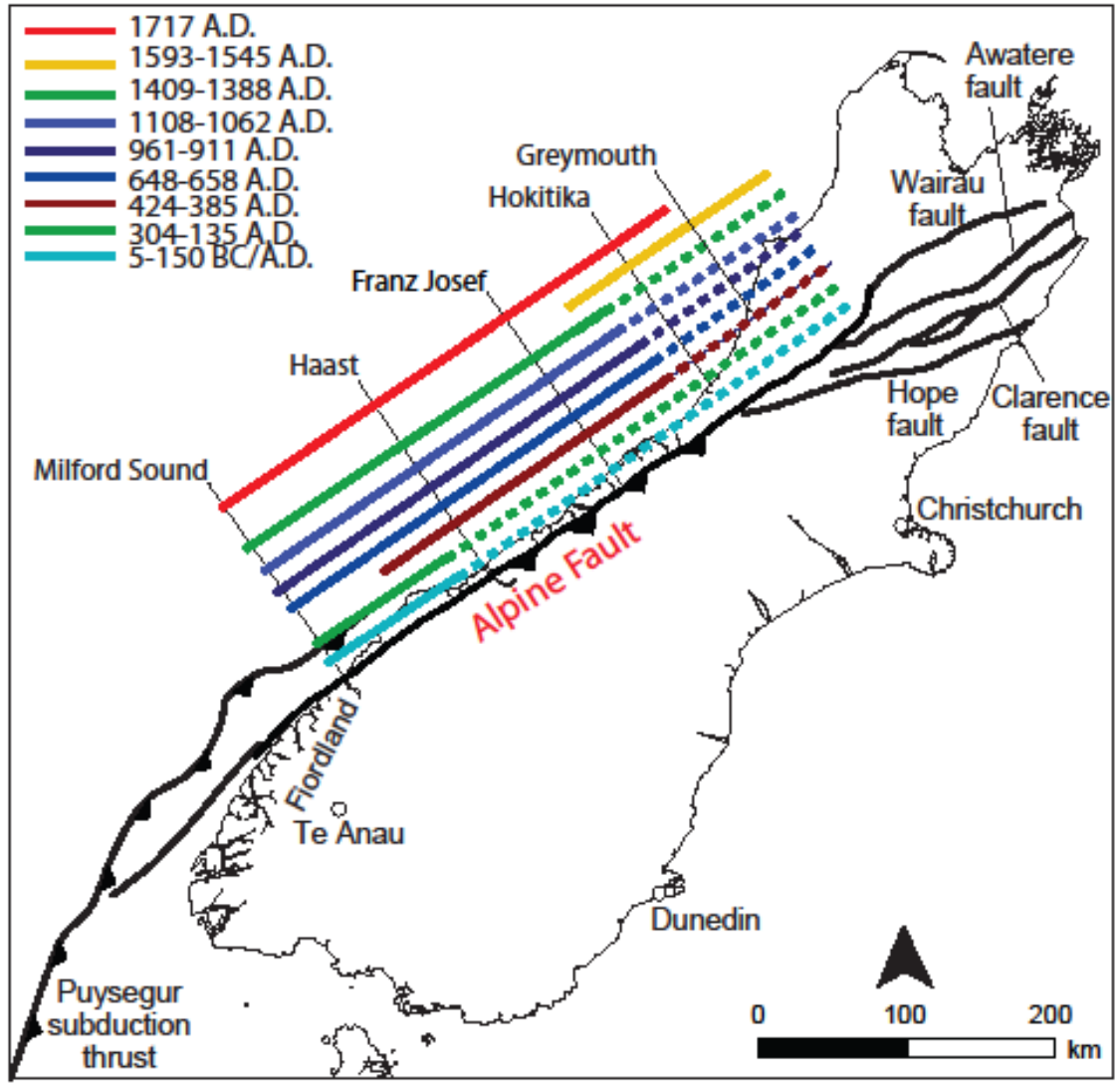
- Longest interval ~510 yrs
- Shortest interval ~140 yrs




Ursula Cochran et al. – GNS Science

# Magnitude

- **Of the last 9 earthquakes, 8 appear to have been >400 km Mw8 events**
- **Fault has stored enough energy to move >8 m horizontally and >2 m vertically**

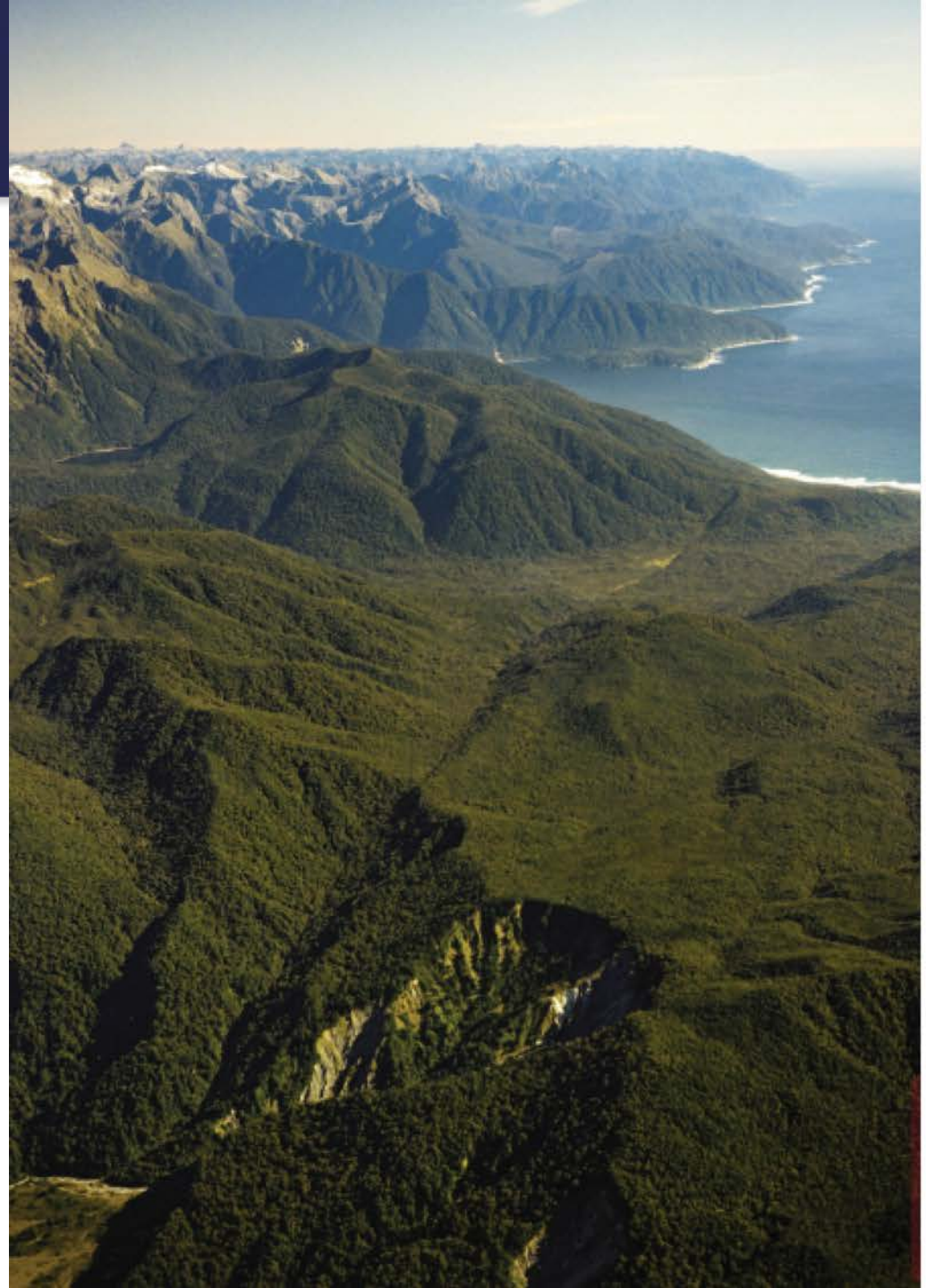



(Cochran et al.; Howarth et al.)

# Magnitude

## Next earthquake likely to be ~Mw8.0

- 32x more energy released than 4 Sept 2010 Darfield EQ (Mw 7.1)
- 1000x more energy released than 22 Feb 2011 Christchurch EQ (Mw 6.2)



# Intensity - Hazard Footprint

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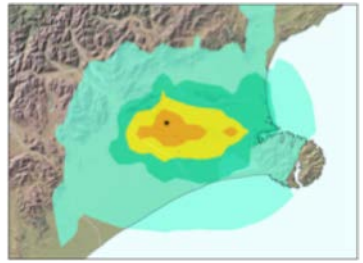
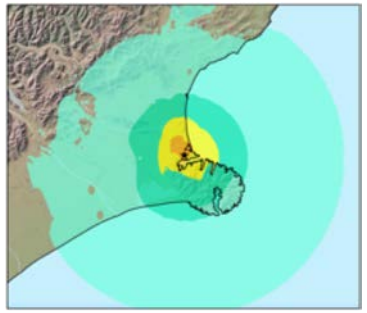
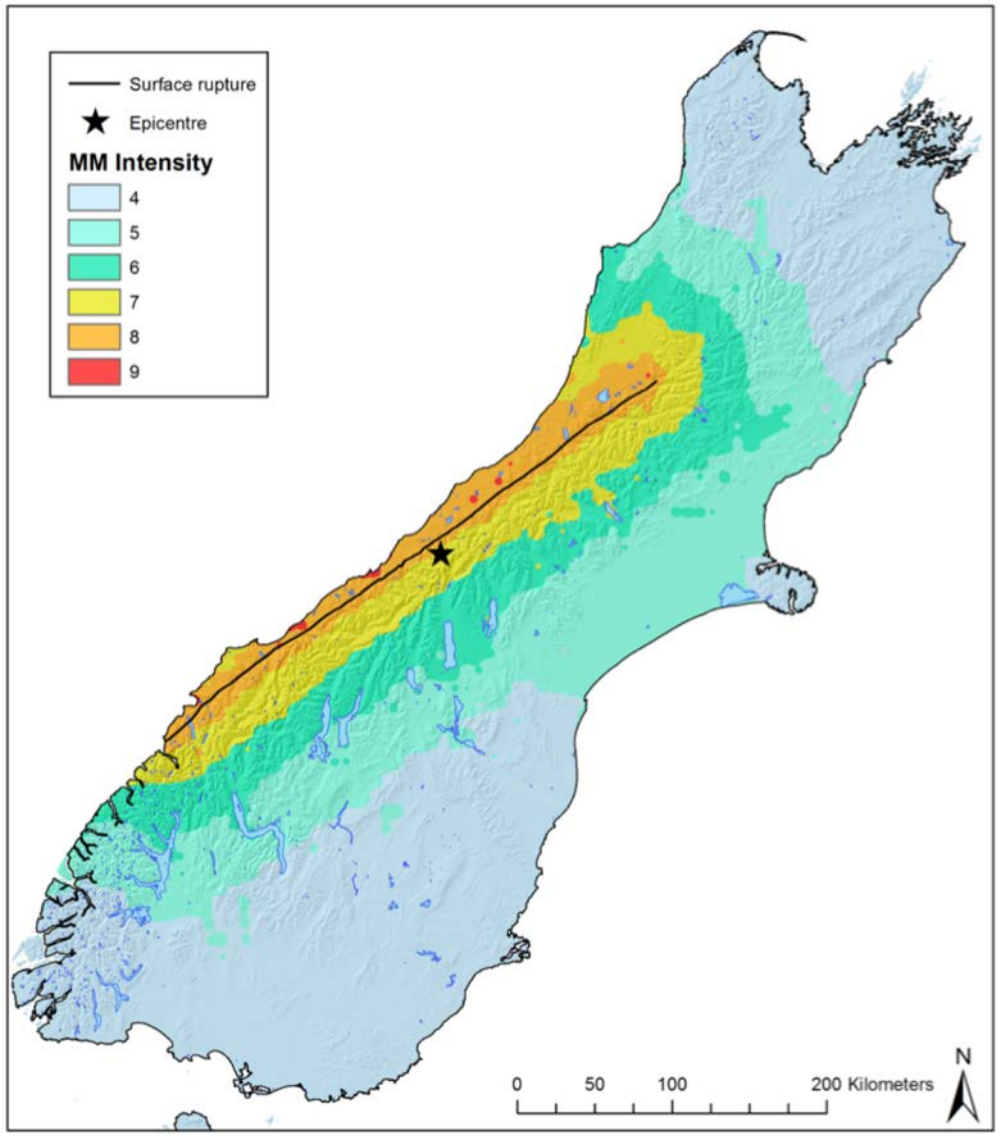
## SHAKING INTENSITY

**4 September 2010**
**Darfield Earthquake**
**(to scale)**



**22 February 2011**
**Christchurch Earthquake**
**(to scale)**

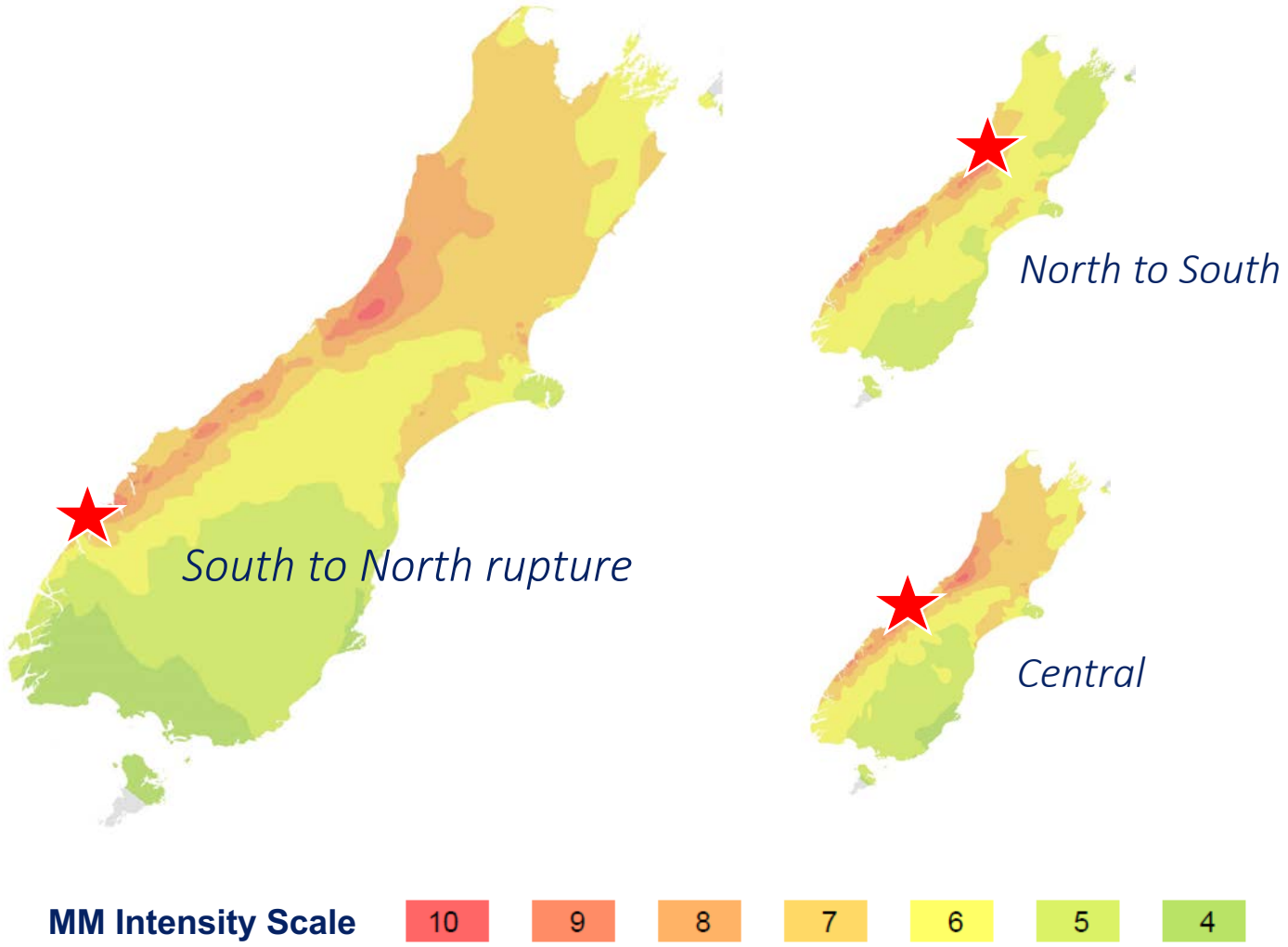




# Science-based Scenarios

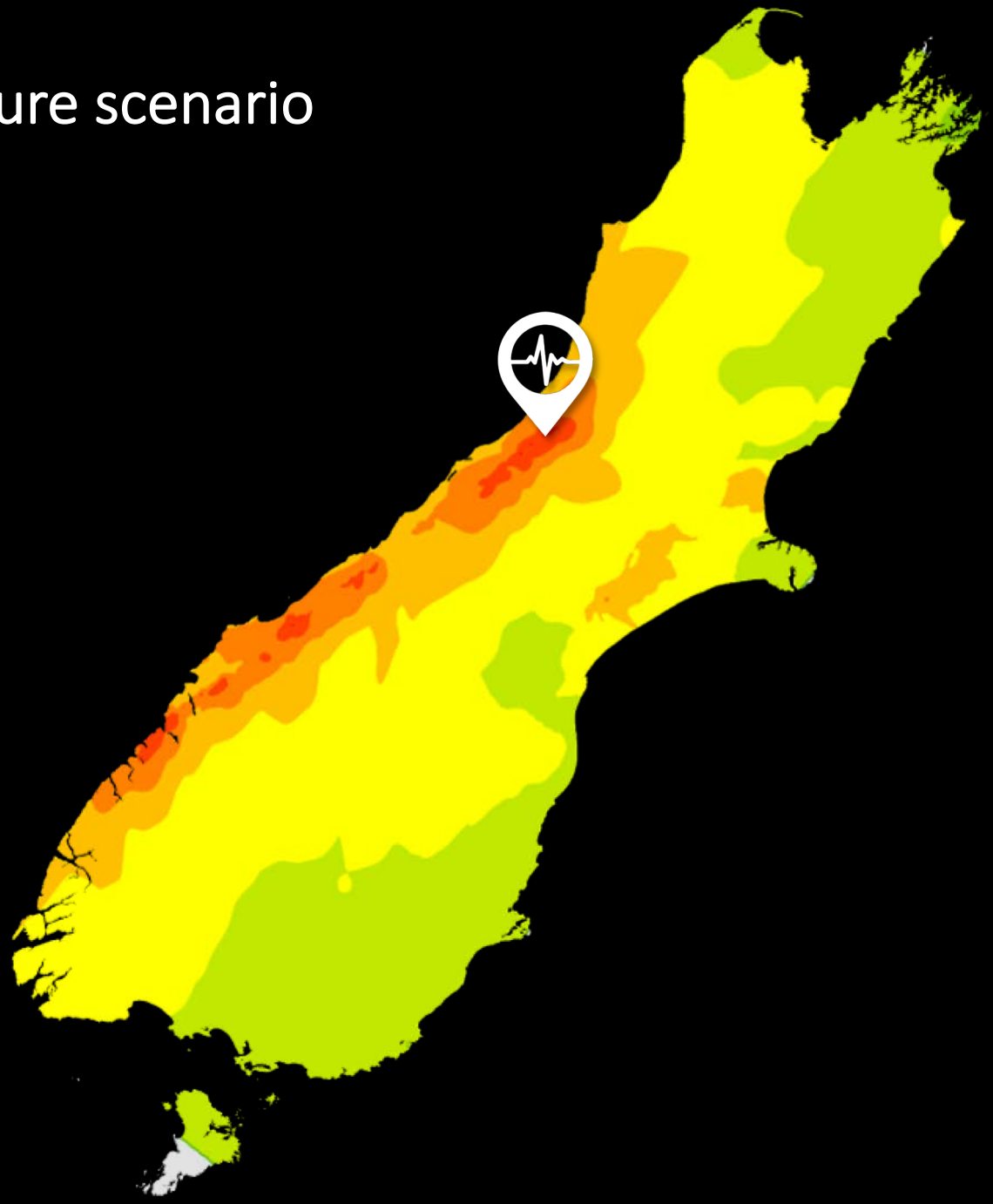
AF8 science scenario:

- Magnitude 8
- MM Intensity 4-10
- Major cascading consequences and secondary hazards
- Significant human, environmental, infrastructure and economic impact

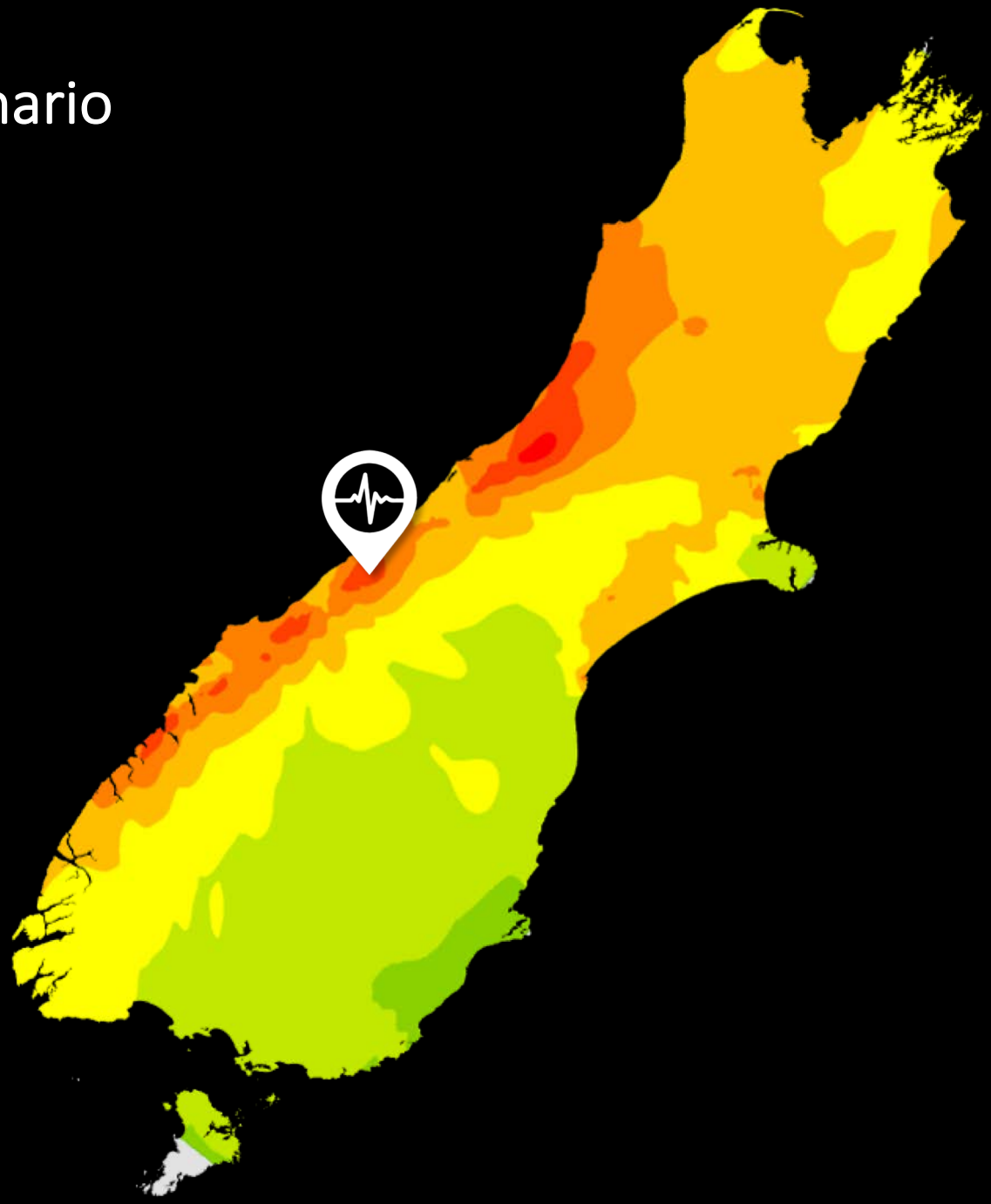



Images: Conrad Zorn. Based on Brendon Bradley et al. (2016)

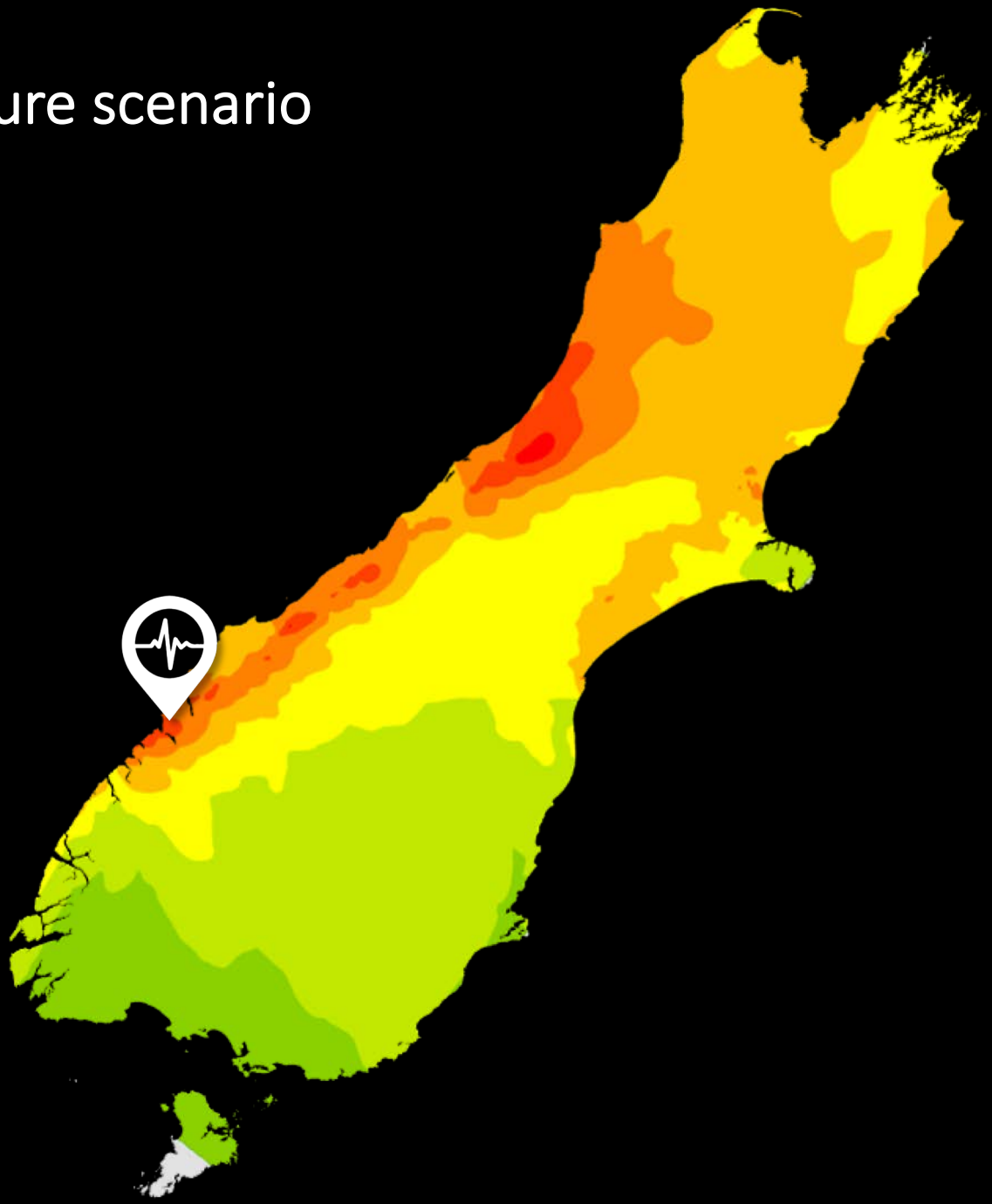
# North to South rupture scenario



# Central rupture scenario



# South to North rupture scenario



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# Earthquake Hazards

# Secondary Hazards

**Earthquakes are not just the initial strong ground shaking**

**They cause a series of secondary hazards which cascade on from each other**

- **+ Aftershocks**
- **+ Weather Events**
- **+ Fire**

**EARTHQUAKE**

**LANDSLIDE**

**QUAKE LAKE**

**DAMBREAK FLOOD**

# Secondary Hazards

**Often these secondary hazards can be worse than the initial shaking:**

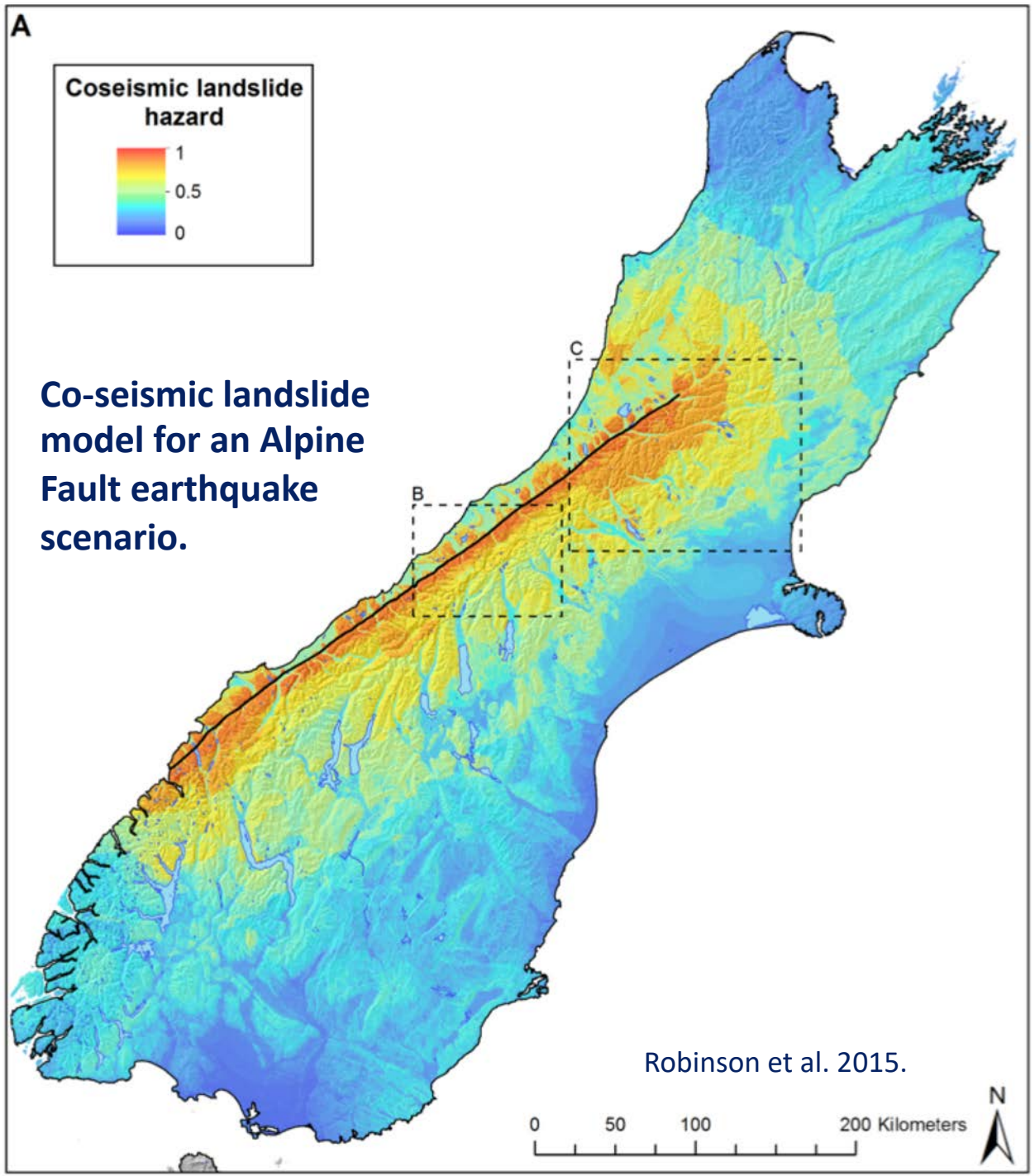
- **2004 Indonesia – Tsunami**
- **2011 Japan – Tsunami**
- **2010-11 Christchurch – Liquefaction & Landslides**
- **2016 Kaikōura – Landslides**

Liquefaction in Christchurch: CEISMIC Digital Archive (Mark Lincoln)

Landslides on SH1 following the Kaikōura earthquake (GeoNet)

# Secondary Hazards

Landslide dam following the 2016 Kaikōura earthquake



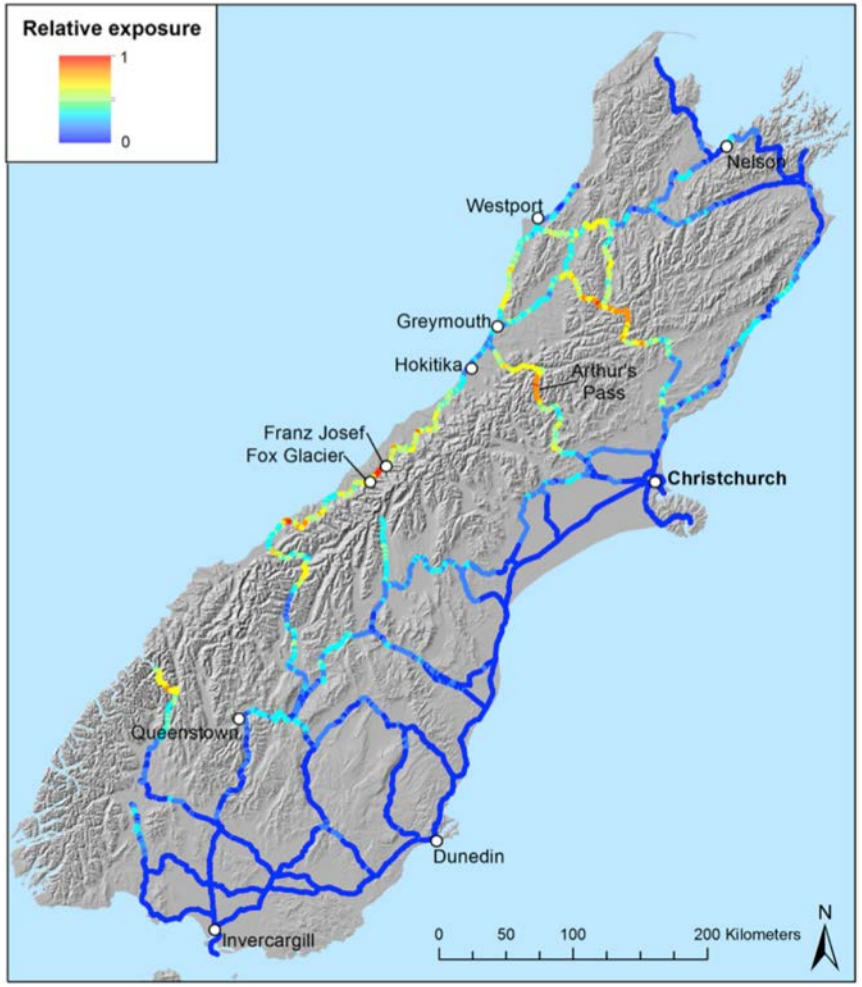

**Co-seismic landslide model for an Alpine Fault earthquake scenario.**

Robinson et al. 2015.

# State Highway Network

## South Island road network exposure

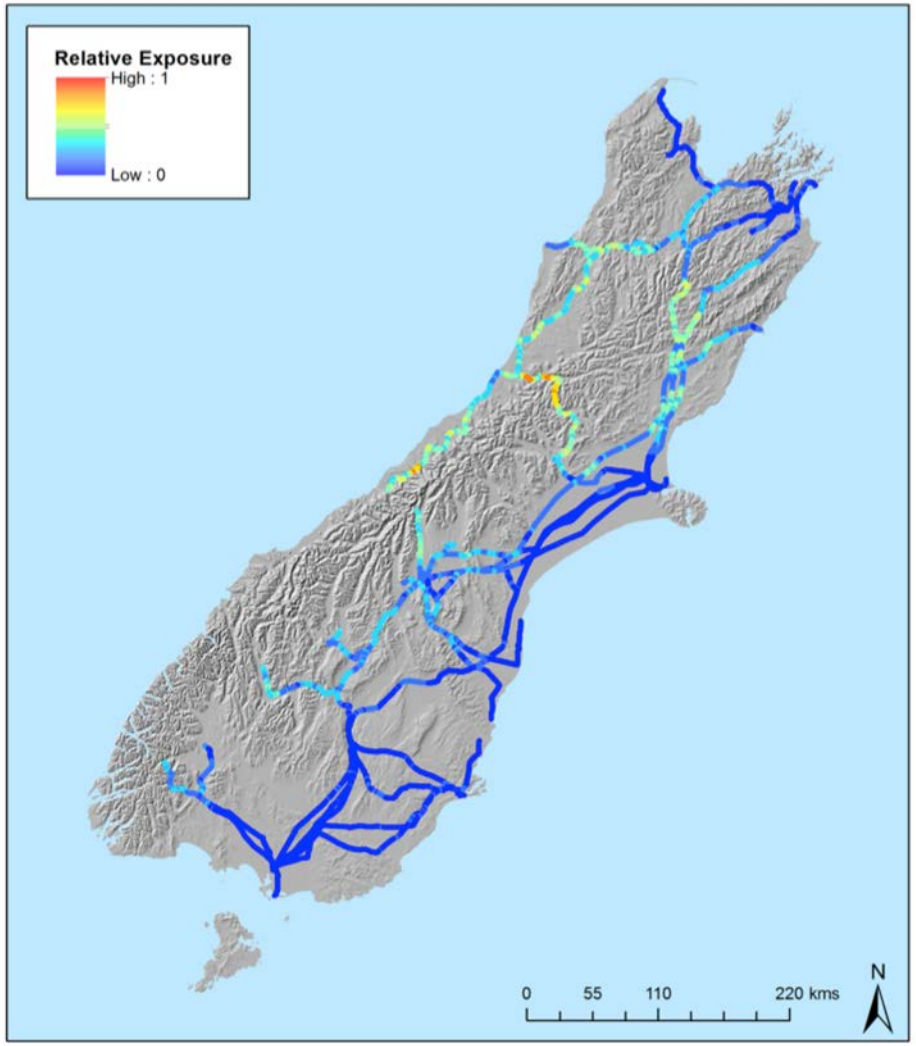
- Traverses steep, landslide prone terrain
- Little redundancy in networks
- Loss of roads will hinder response and recovery
- Road closures will have long term impacts on economy


State Highway network exposure to Alpine Fault co-seismic landslide scenario (Robinson et al. 2015)

# Electricity Network

- Pylon/poles damaged
- Transformers damaged
- Dam shutdowns - restart requires power
- Inter-island connection vulnerable
- Implications for North Island supply




Transmission network exposure to Alpine Fault co-seismic landslide scenario (Robinson et al. 2015)

Benmore Dam

# Telecommunications Network

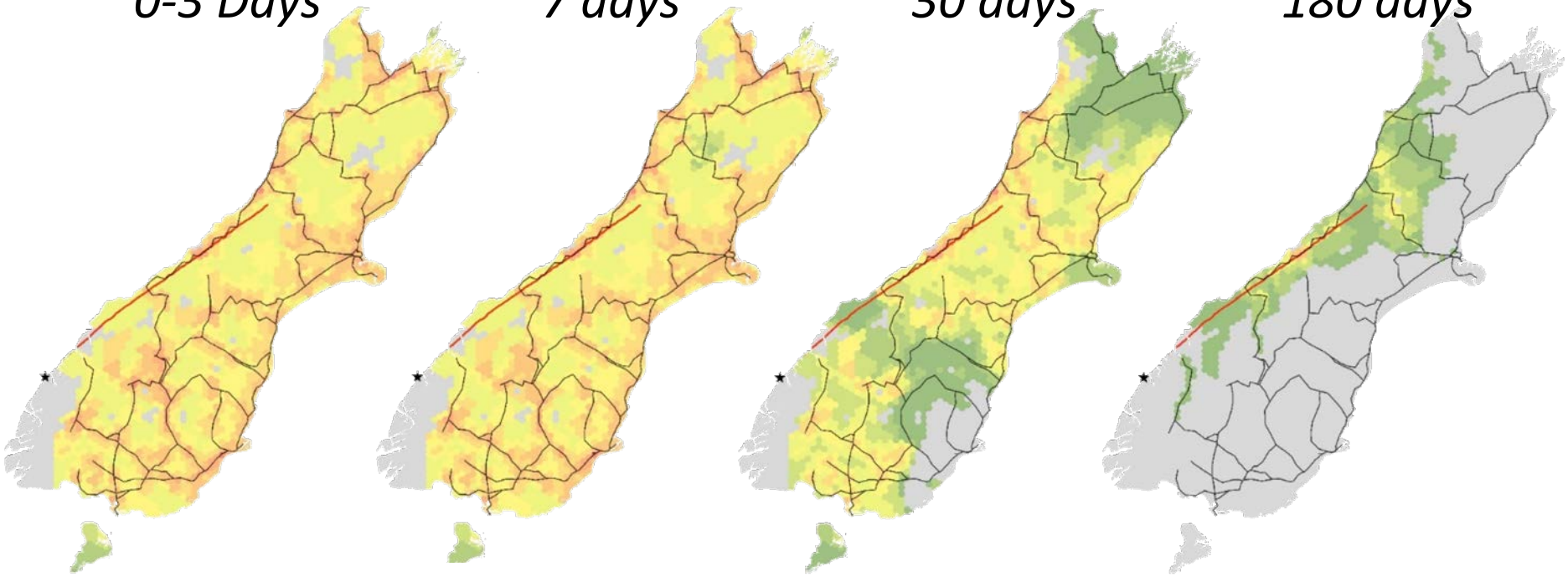
- Telecommunications increasingly important for post-disaster response coordination and community well-being
- Disruption due to loss of electricity and loss of access to site (generator + fuel) estimated to be largest impact

# Infrastructure recovery

## AF8 Scenario:

Recovery of cumulative disruption of infrastructure networks

*0-3 Days* *7 days* *30 days* *180 days*



Number of infrastructure systems with some level of disruption

# What next for AF8?

# Year 4 2019-20

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**Response**

- National Exercise Planning
- SAFER Planning
- Multi-agency planning

**Engagement**

- Science outreach
- Public Education
- *Science Beneath Our Feet* roadshow and forums

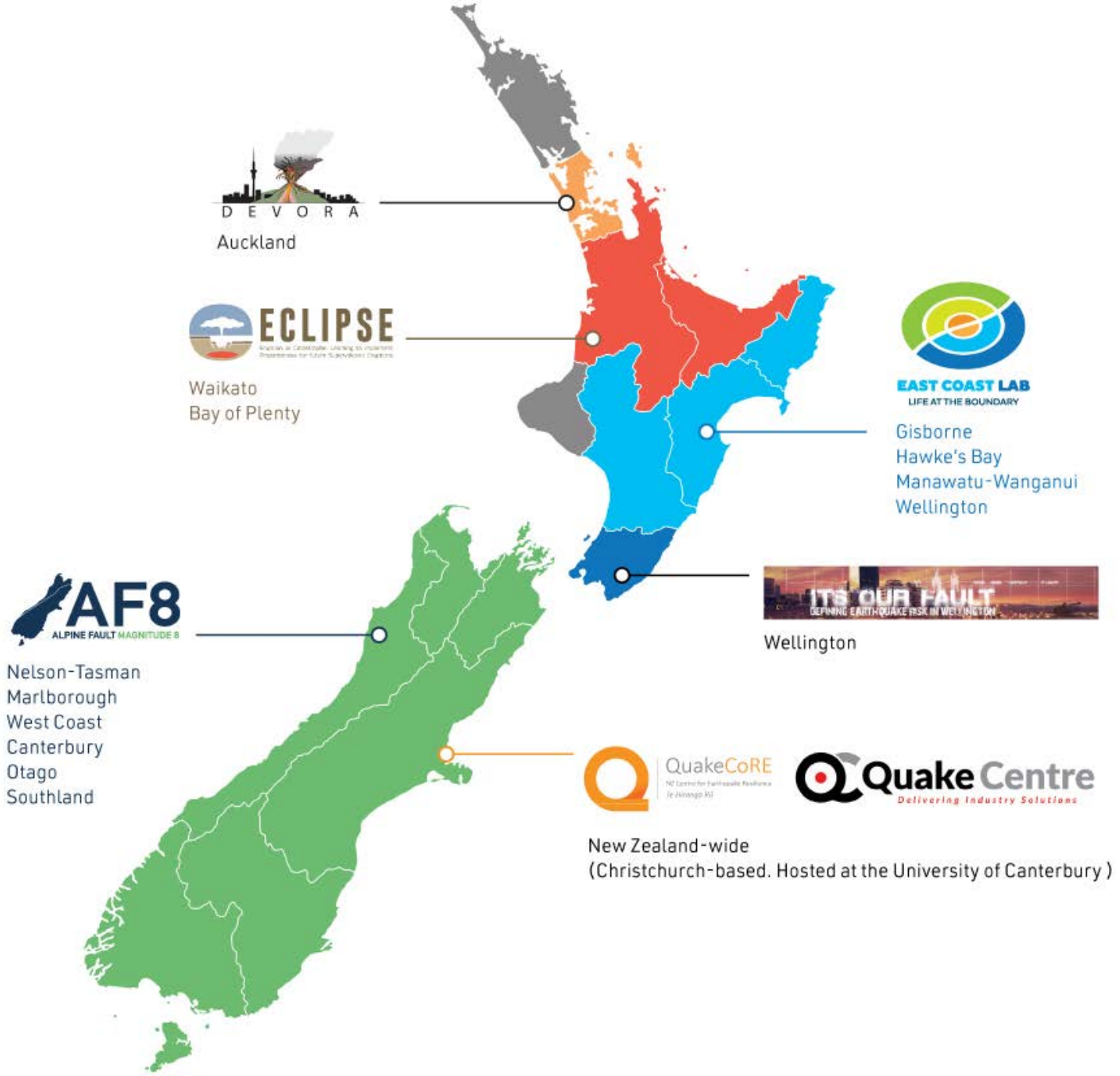
**Risk Communication**

- Digital media
- Coordinated communication across national projects

**Recovery**

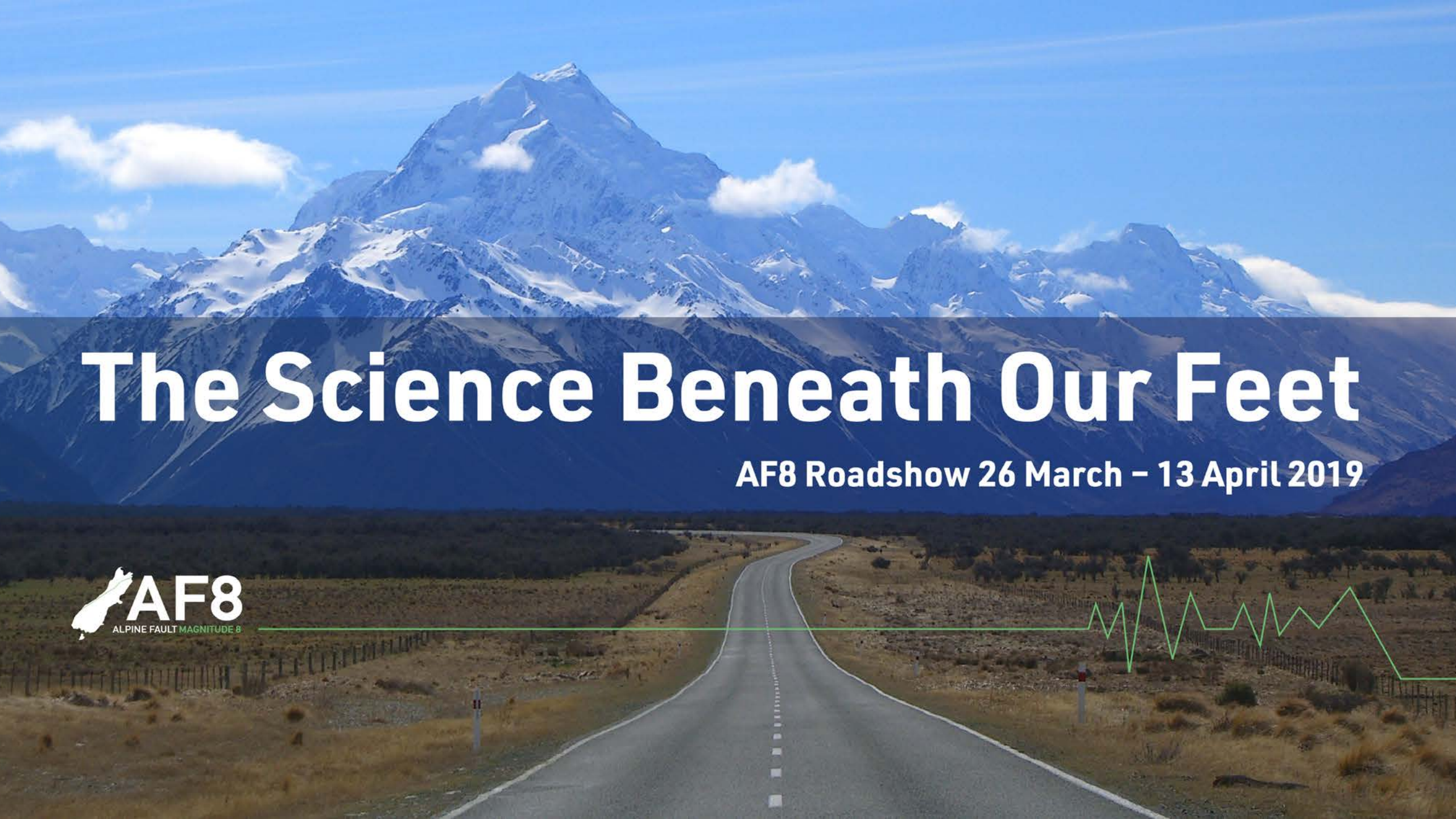
- Tourism
- Economic
- Hazard Science
- Cultural / Community

# Regional Natural Hazard Programme Alliances



# Outreach and Engagement

- Tier 3 South Island AF8 Exercise, November 2019
- Tier 4 National Exercise on the Alpine Fault, October 2020




# The Science Beneath Our Feet

## AF8 Roadshow 26 March – 13 April 2019

# AF8 Roadshow

## AF8 Roadshow

## The Science Beneath Our Feet

Bringing Alpine Fault science and hazard impact information to South Island communities, in areas most likely to be affected by an AF8 earthquake.

## Sharing the Science Beneath Our Feet

**14** LOCATIONS

**11** SCHOOLS

**26** DAYS

**1110+** PEOPLE
AT THE SCIENCE TALKS

**1100+** STUDENTS
YEARS 7-13

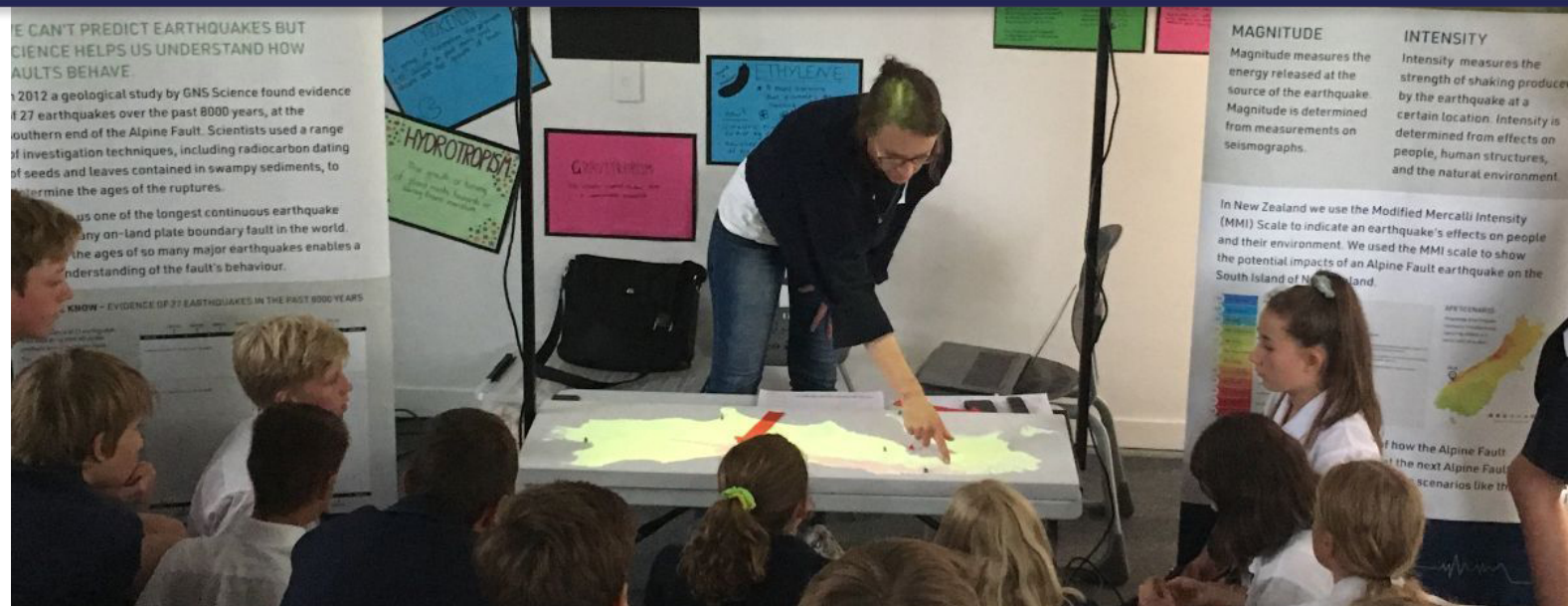
**5298** KMS
6.5 x THE LENGTH OF THE ALPINE FAULT

| | |
|---|---|
| **6** CDEM Groups | **12** Emergency Management Officers |
| **6** Scientists | **1** Communicator |

# AF8 Roadshow

## The Science Beneath Our Feet

- Interactive school sessions with Y7-13 students
- Community Science Talks

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# TOURISM FORUM

26 September 2019

Distinction Hotel | Te Anau


AF8
@alpinefault8

Followers you know | Followers

**Hon. Peeni Henare MP**
@PeeniHenare Follows you

Member of Parliament for Tāmaki Makaurau
MP, Parliament Buildings, Wellington).

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# SAFER

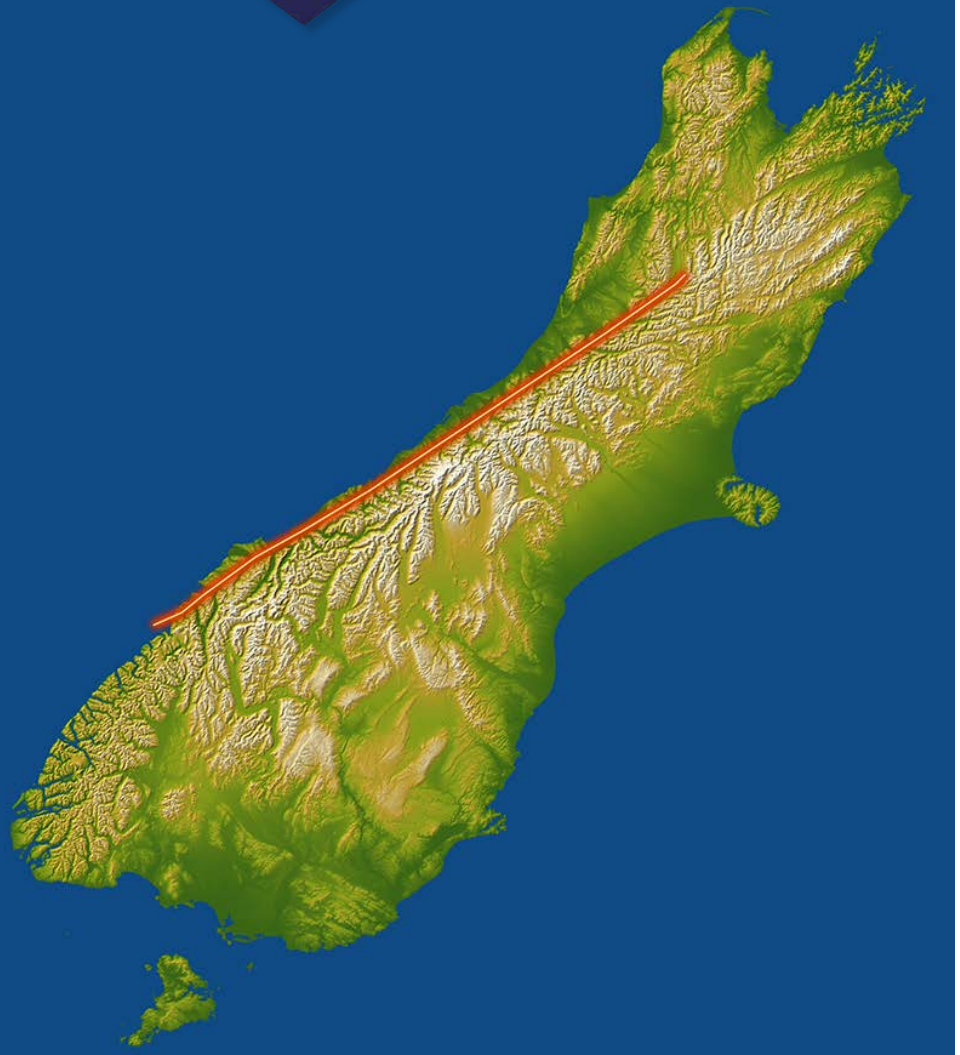
SOUTH ISLAND / TE WAIPONAMU
ALPINE FAULT EARTHQUAKE RESPONSE

# FORUM

**23 October 2019 | Nelson**

# Society of Local Government Managers – Excellence in collaborative governance, 2019

# AF8 – KEY MESSAGES



- High chance next AF earthquake will be a Mw8
- Effects across South Island and lower North Island
- Widespread secondary hazards (e.g. landsliding) will present immediate and long-term issues
- Likely isolation of areas for long periods of time, and extended utility service outages
- 'Scenario earthquakes' never quite what is expected
- Strong pre-existing networks essential

- An Alpine Fault earthquake will happen again
  Preparation is key

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# Thank you!

www.af8.org.nz

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National SCIENCE Challenges

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NEW ZEALAND