

IT'S OUR FAULT

N Ō M Ā T O U T E H A P A

Increasing Our Resilience

TE WHAKAPIKI MANAHAU

WELLINGTON EARTHQUAKE
RESEARCH PROGRAMME

Nicola Litchfield (IOF Science Leader)
Wellington Earthquake Research Collaboratory Meeting
10 November 2022

Toka
Tū Ake
EQC

Absolutely Positively
Wellington City Council

Me Heke Ki Pōneke





Increasing Our Resilience
TE WHAKAPIKI MANAHAU

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RESEARCH PROGRAMME

Talk outline:

- Programme goal
- Some highlights of the first 10 years
- Results from the ~5 years
- 2022/23 projects and early results



Increasing Our Resilience
TE WHAKAPIKI MANAHAU

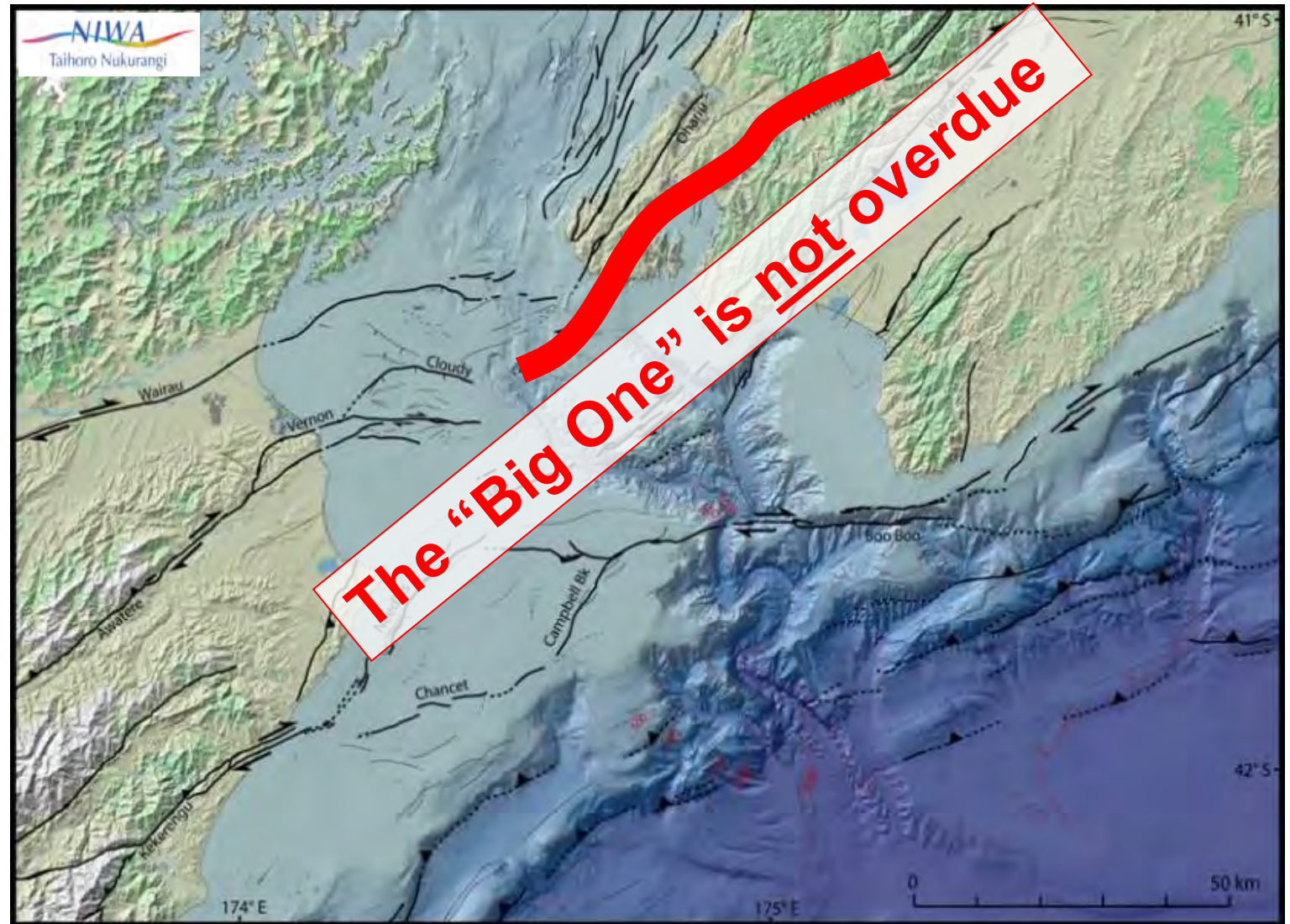
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RESEARCH PROGRAMME

The Goal (since 2006)

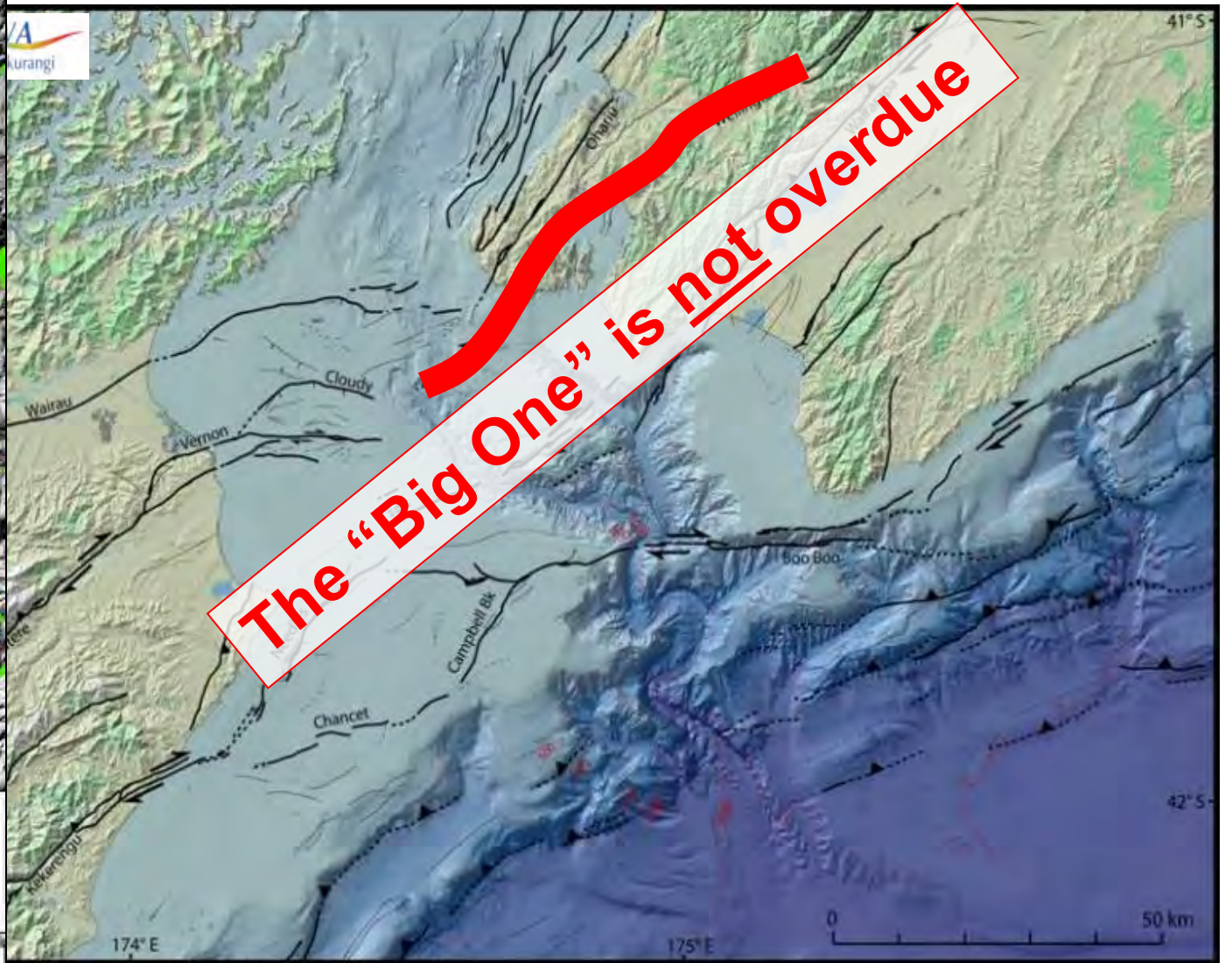
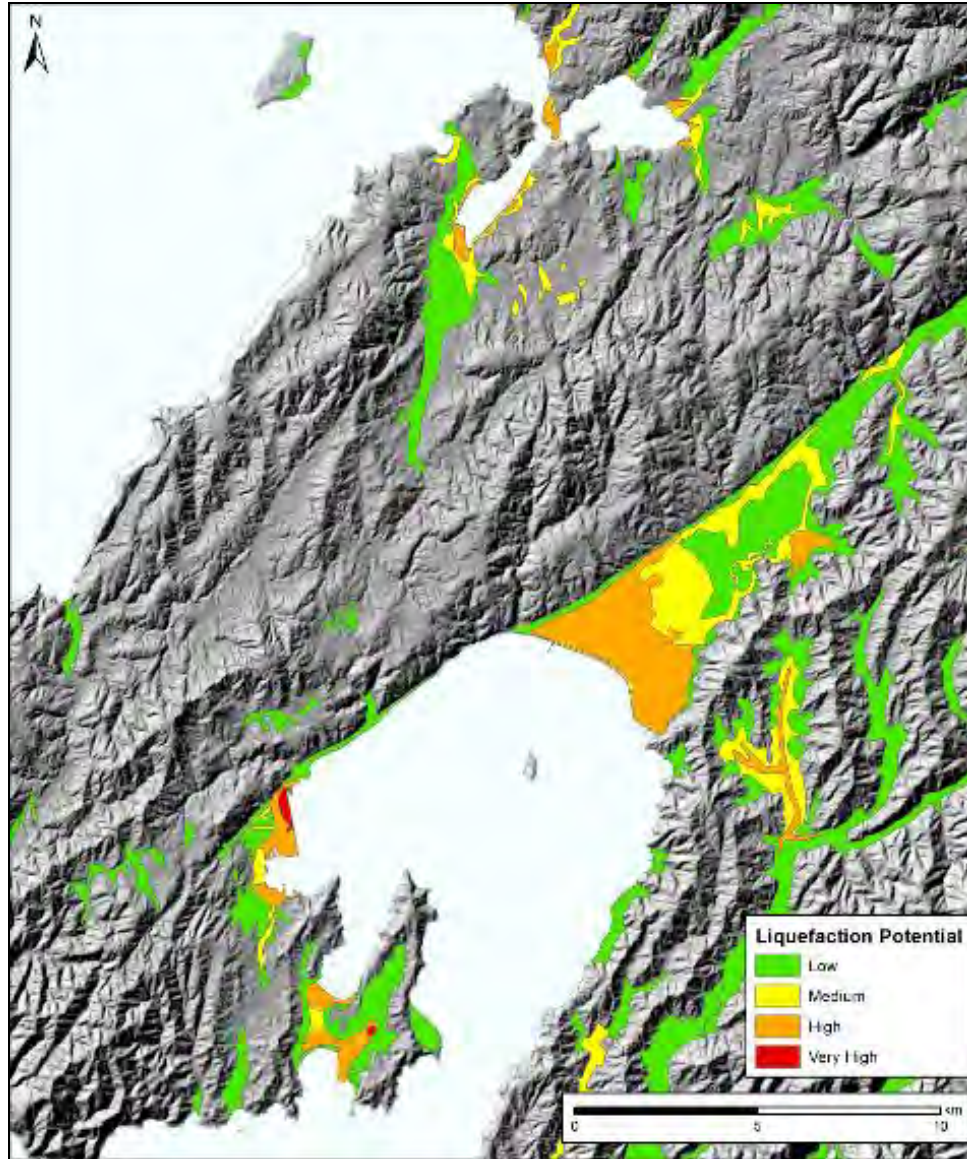
To see **Wellington** positioned to become a **more resilient** region through a comprehensive study of:

- the *likelihood* of large Wellington earthquakes,
- the *effects* of these earthquakes, and
- their *impacts* on humans and the built environment.

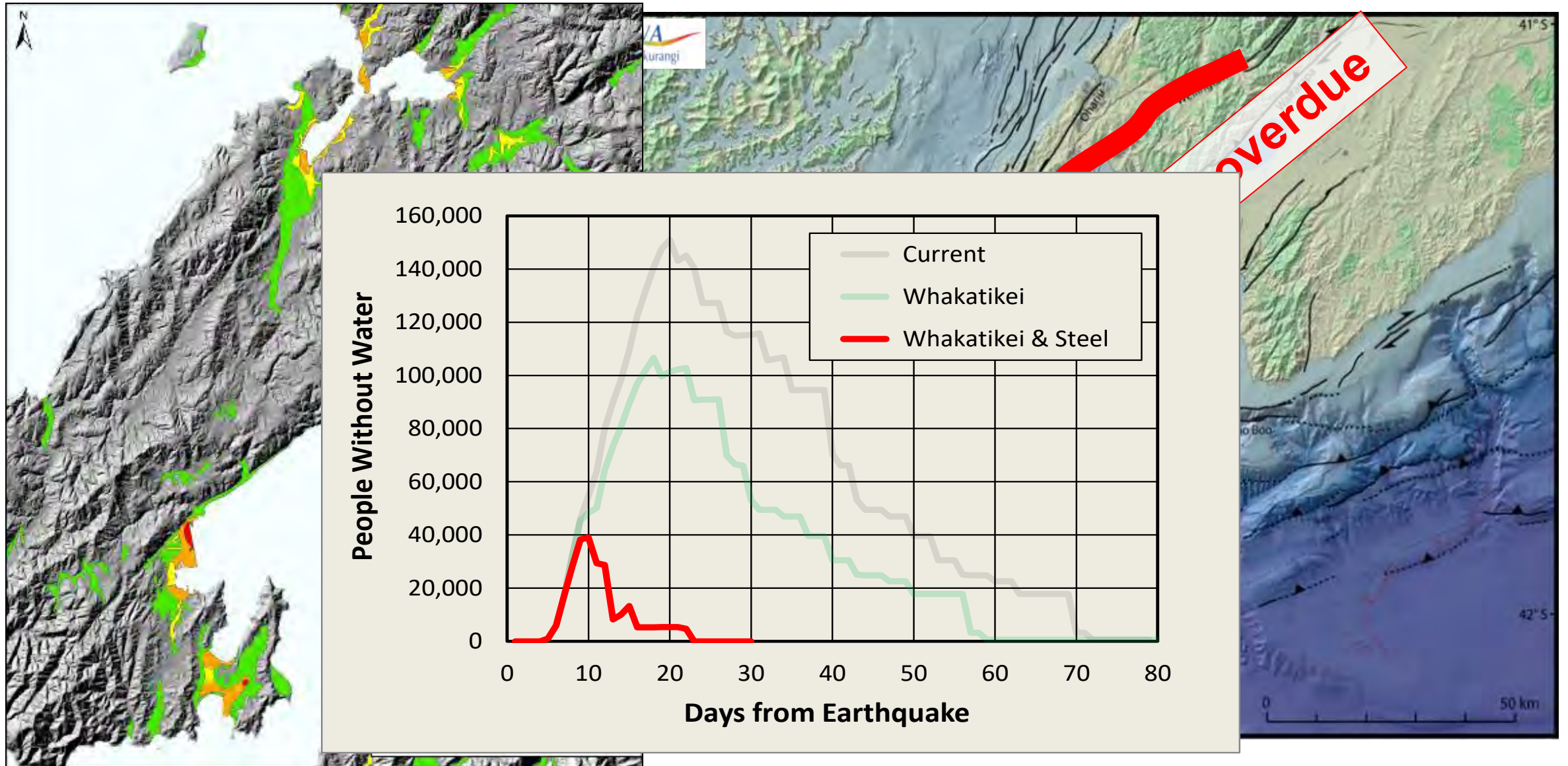
Some accomplishments in the first 10 years



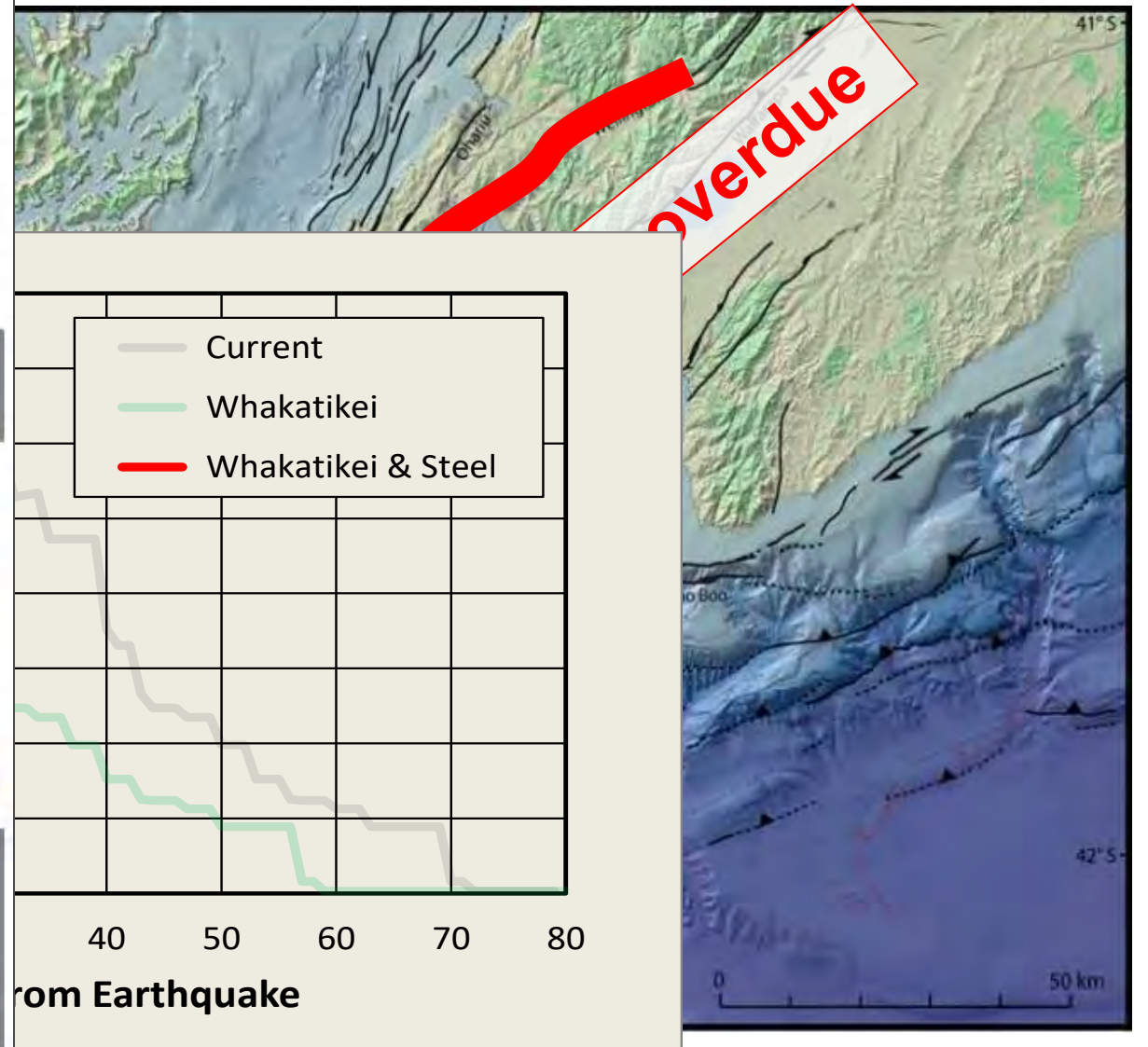
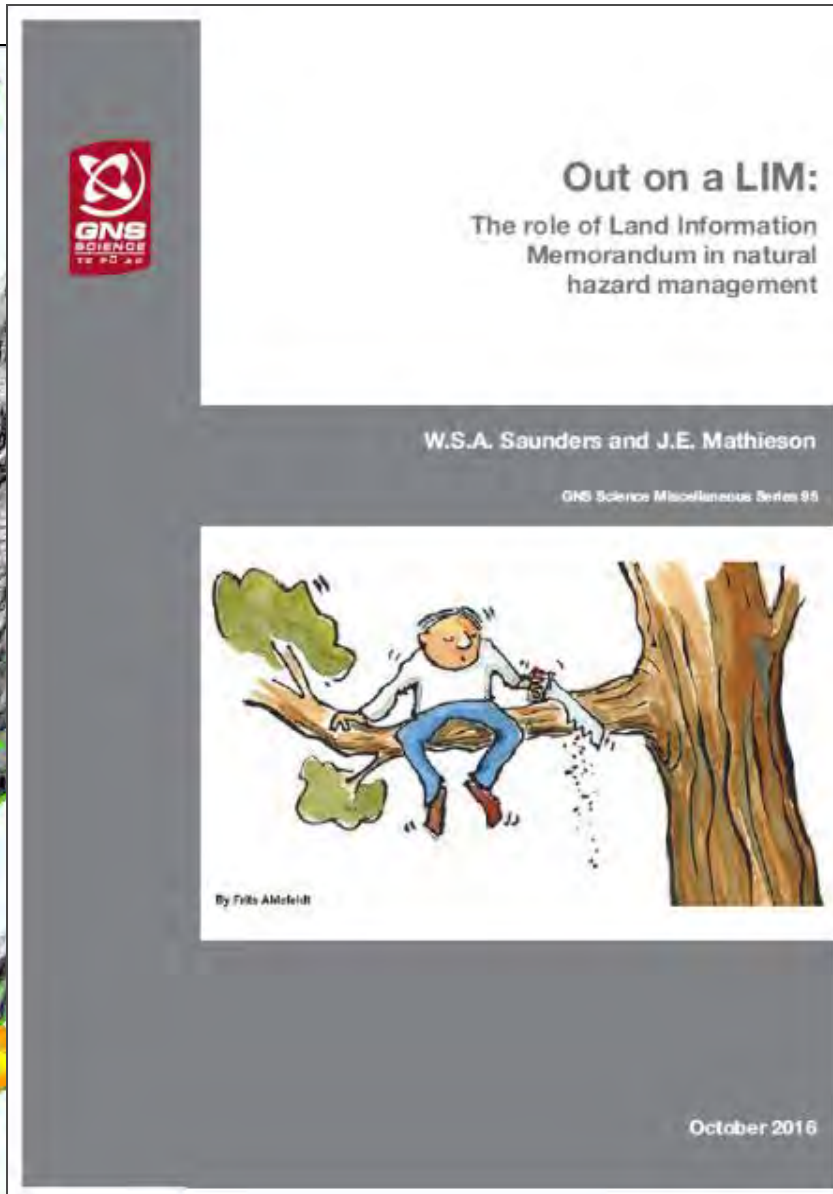
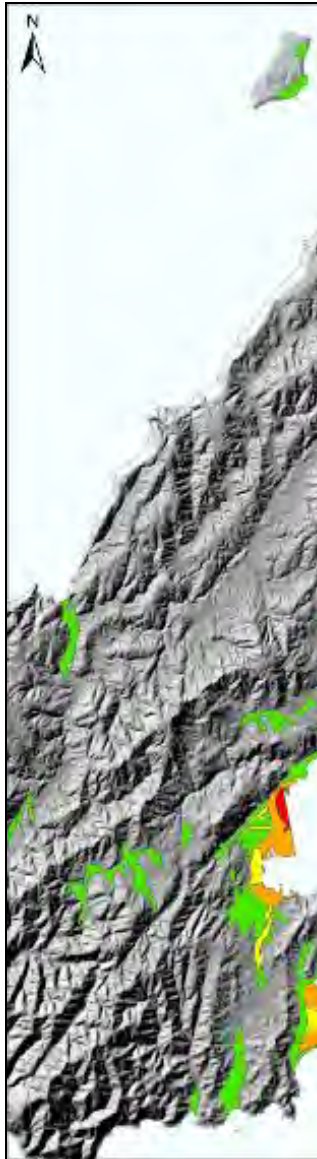
Some accomplishments in the first 10 years



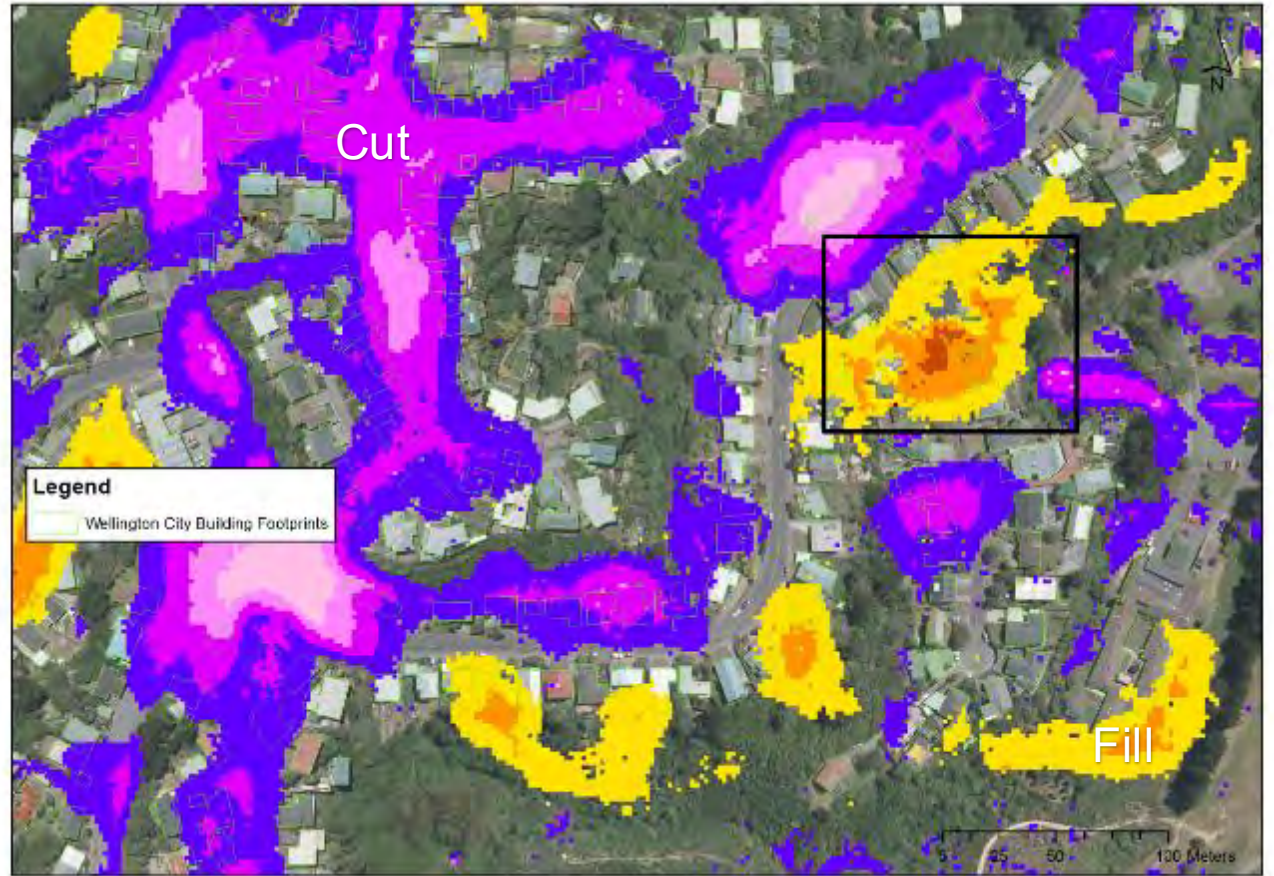
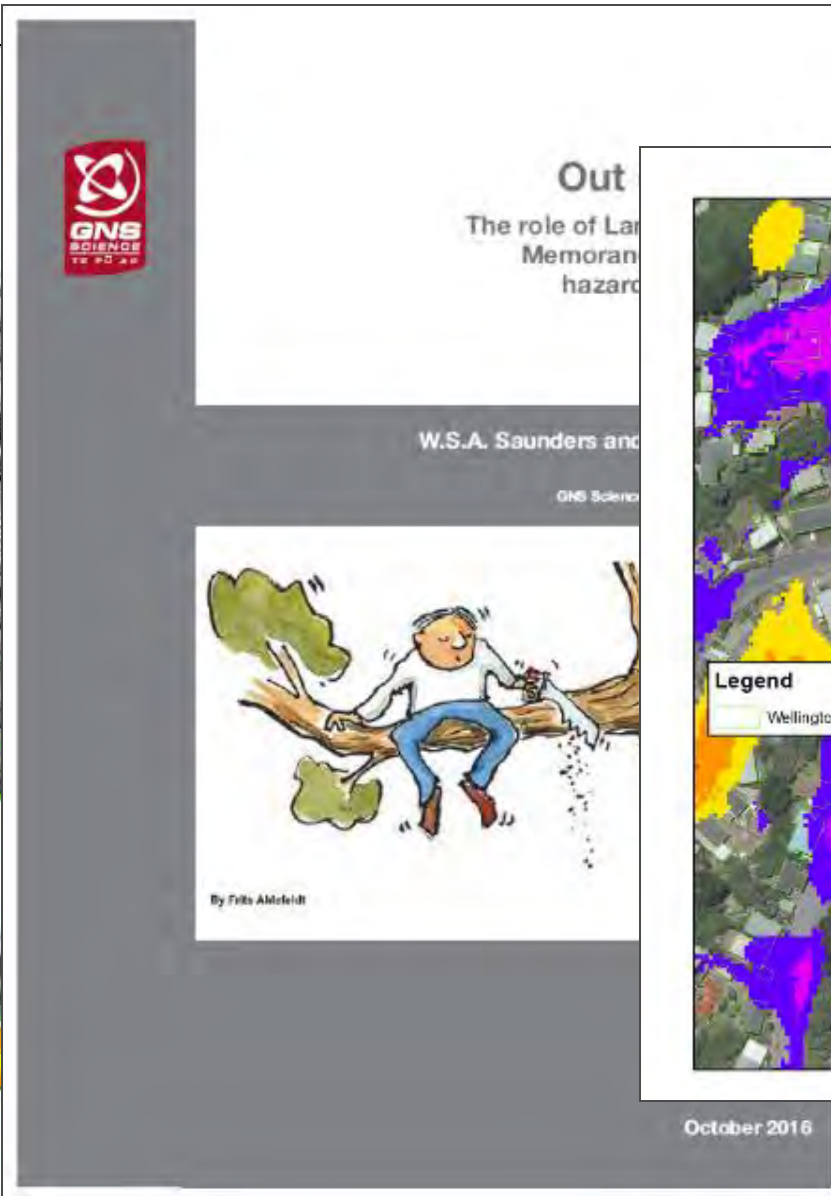
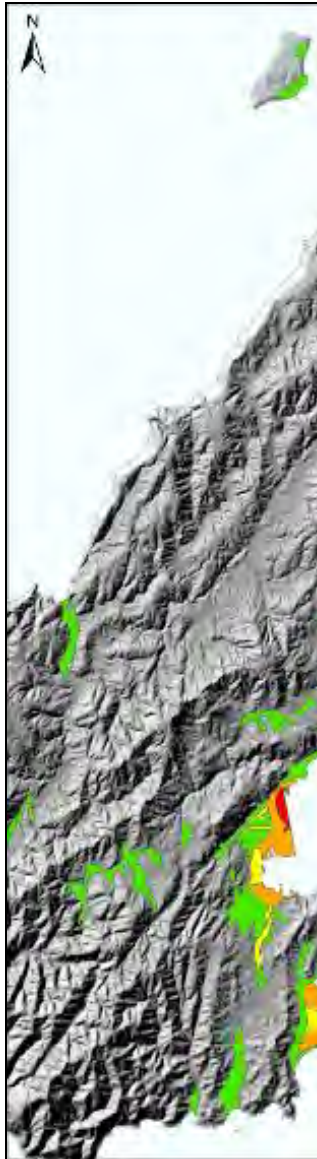
Some accomplishments in the first 10 years



Some accomplishments in the first 10 years

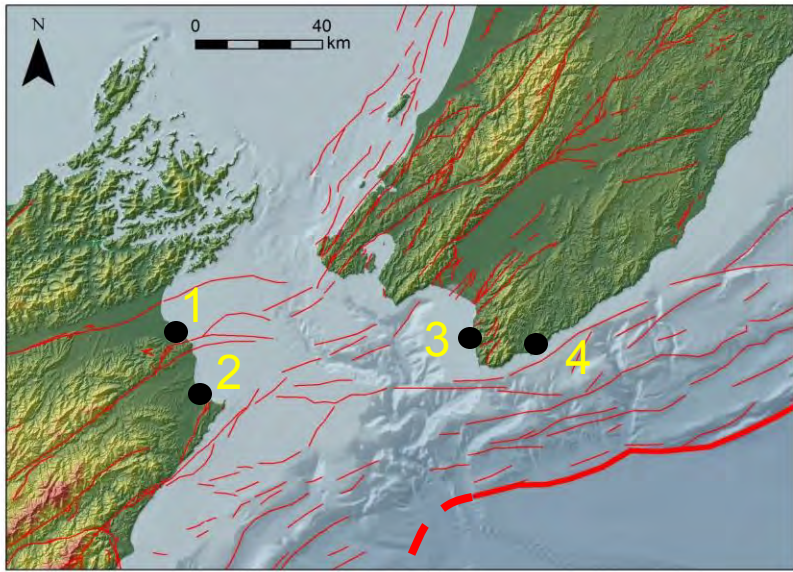


Some accomplishments in the first 10 years



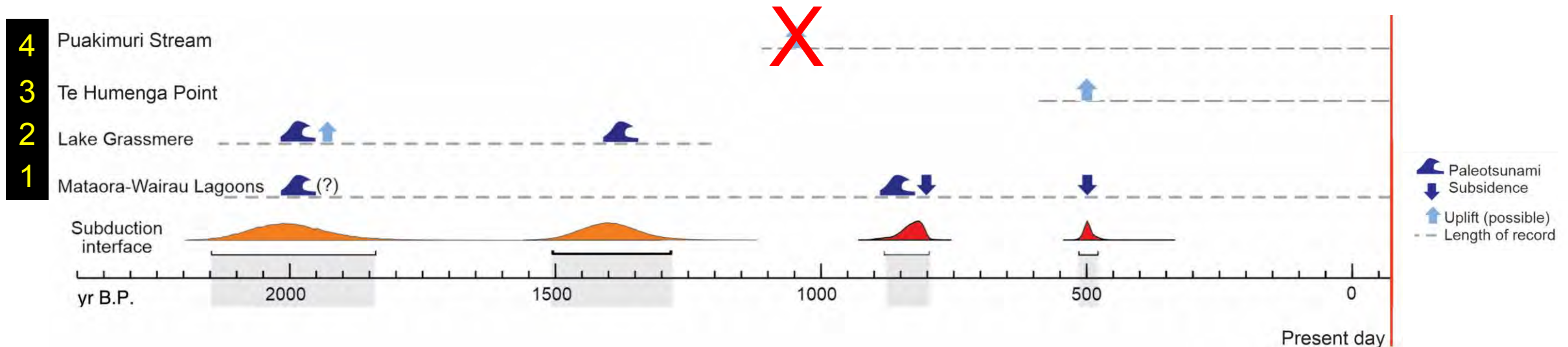
October 2016 from Earthquake





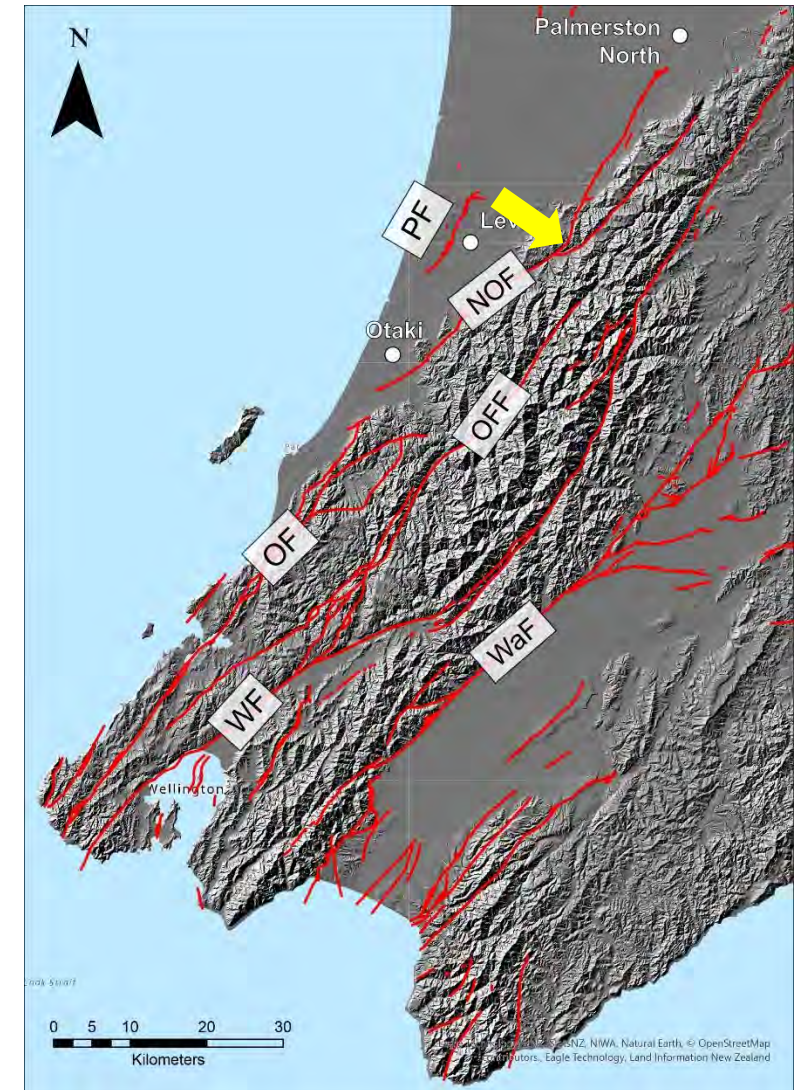
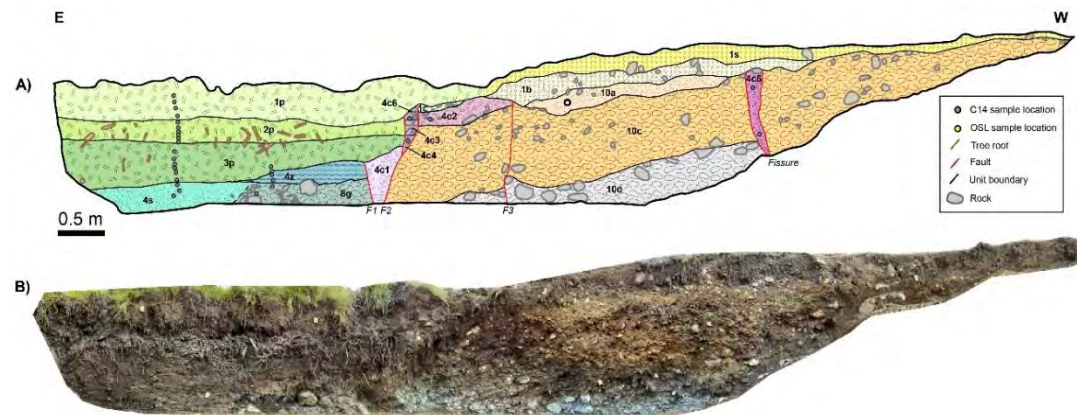
Results from the last ~5 years – Hikurangi Subduction Zone

- 4 Hikurangi subduction earthquakes in the last ~2000 years
 - Recurrence interval ~500 years
 - 25% probability in the next 50 years
- One earthquake uplifted the Wellington Region at Palliser Bay (site 3), but neither earthquake appears to have extended as far as Tora (Site 4)

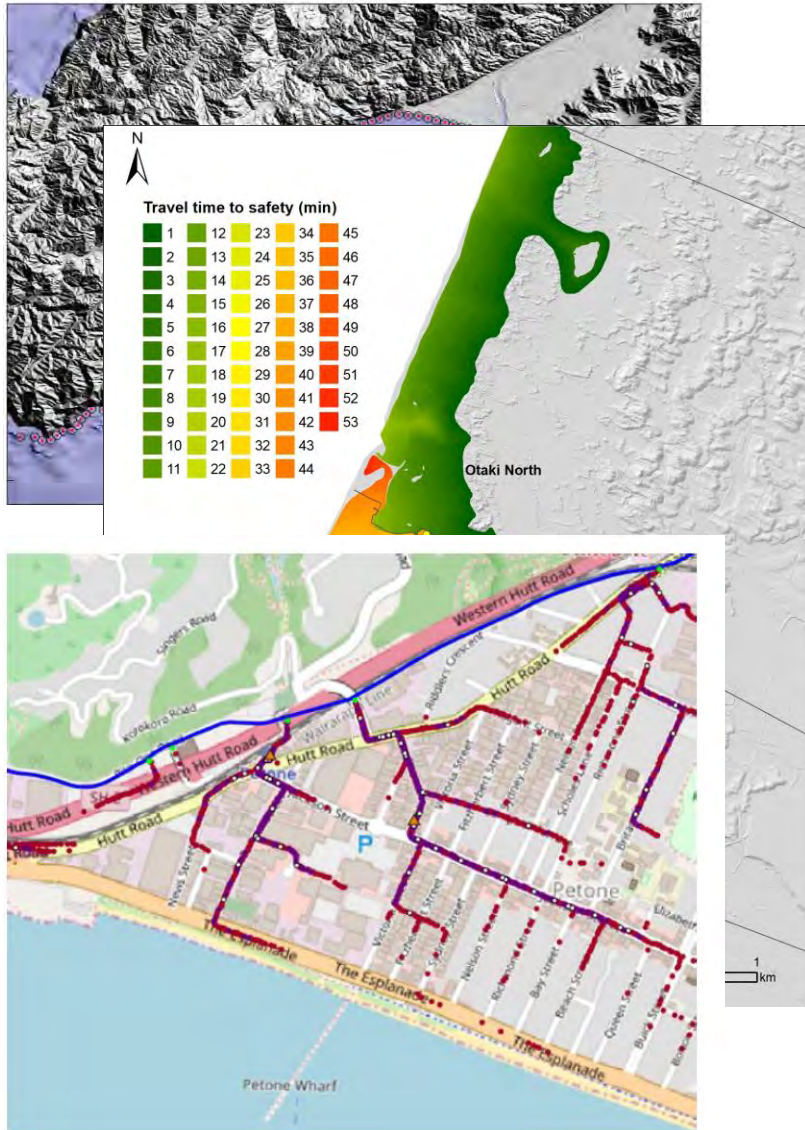


Northern Ōhāriu Fault paleoseismology

- Two trenches on the western branch (Tokomaru Fault) near Levin
- Two earthquakes ~200 and ~1100 years ago as well as some older ones
- Preliminary recurrence interval 400-2300 years
- The two earthquakes match those on the Ōhāriu Fault - suggesting either rupture in a single earthquake (~M7.9), or close in time (within the dating uncertainties, decades)

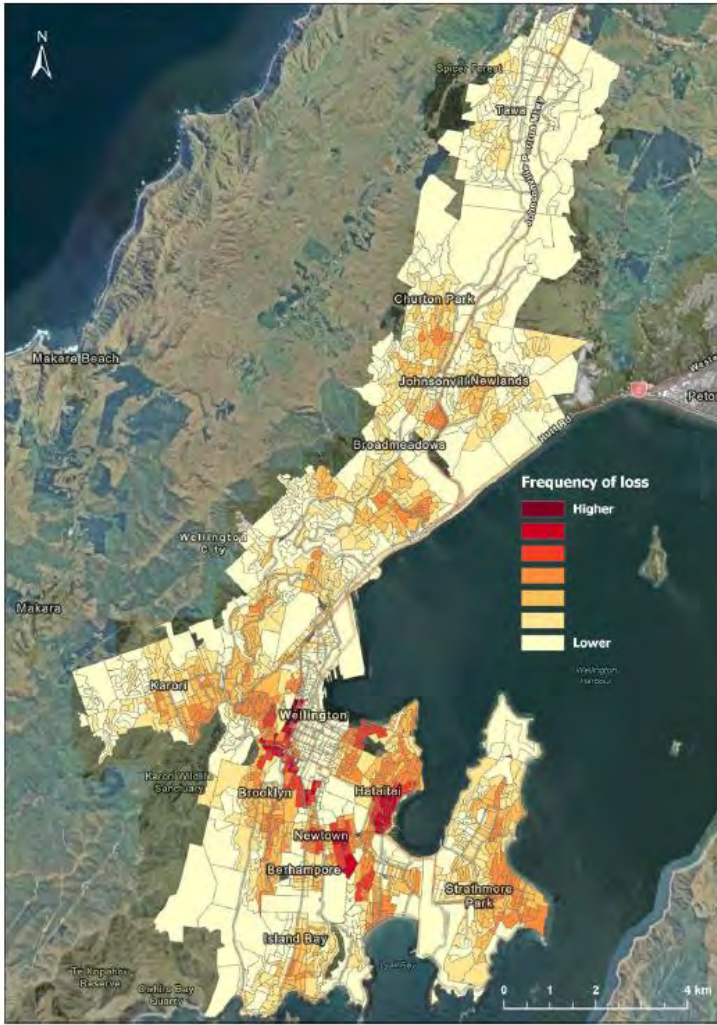


Tsunami Hazard and Vulnerability



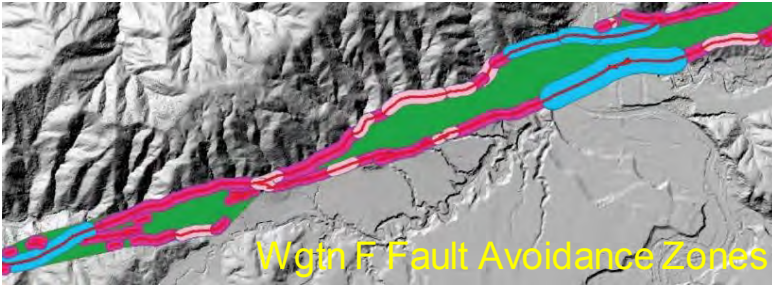
- **Arrival time estimates for local tsunami**
 - Wellington suburbs (Wang et al. 2017)
 - Porirua and Kāpiti Coast (Wang et al. 2021)
- **Evacuation time estimates for local tsunami**
 - Wellington suburbs (Lukovic et al. 2017)
 - Porirua and Kāpiti Coast (Heron et al. 2019)
- **Agent-based evacuation modelling**
 - Wellington CBD (Power et al. 2021)
 - Wellington south coast and Porirua (Power et al. 2022)
 - Southern Kāpiti Coast (to be reported with northern Kāpiti Coast work this year)

Fire following earthquakes



- Last Wellington FFE modelling undertaken in 2002 (Cousins). Identified and applied a USA fire initiation model and developed a new fire spread model which includes both wind and speed direction.
- Relatively high risk in suburbs with wooden buildings and high population density, as well as certain demographic groups (e.g., >65 or <10 yr olds, renters, Māori and Pasifika)
- Modelled 5 potential earthquake scenarios and calculated losses:
 - Hikurangi Subduction Zone \$3B
 - Wellington and Wairarapa faults \$2B each
 - Wairau fault \$0.3B
- Discussed results with FENZ, WCC, WREMO, Wellington Water, NEMA, WeLG, contributing the FENZ business case
- Reviewed global risk reduction and mitigation strategies

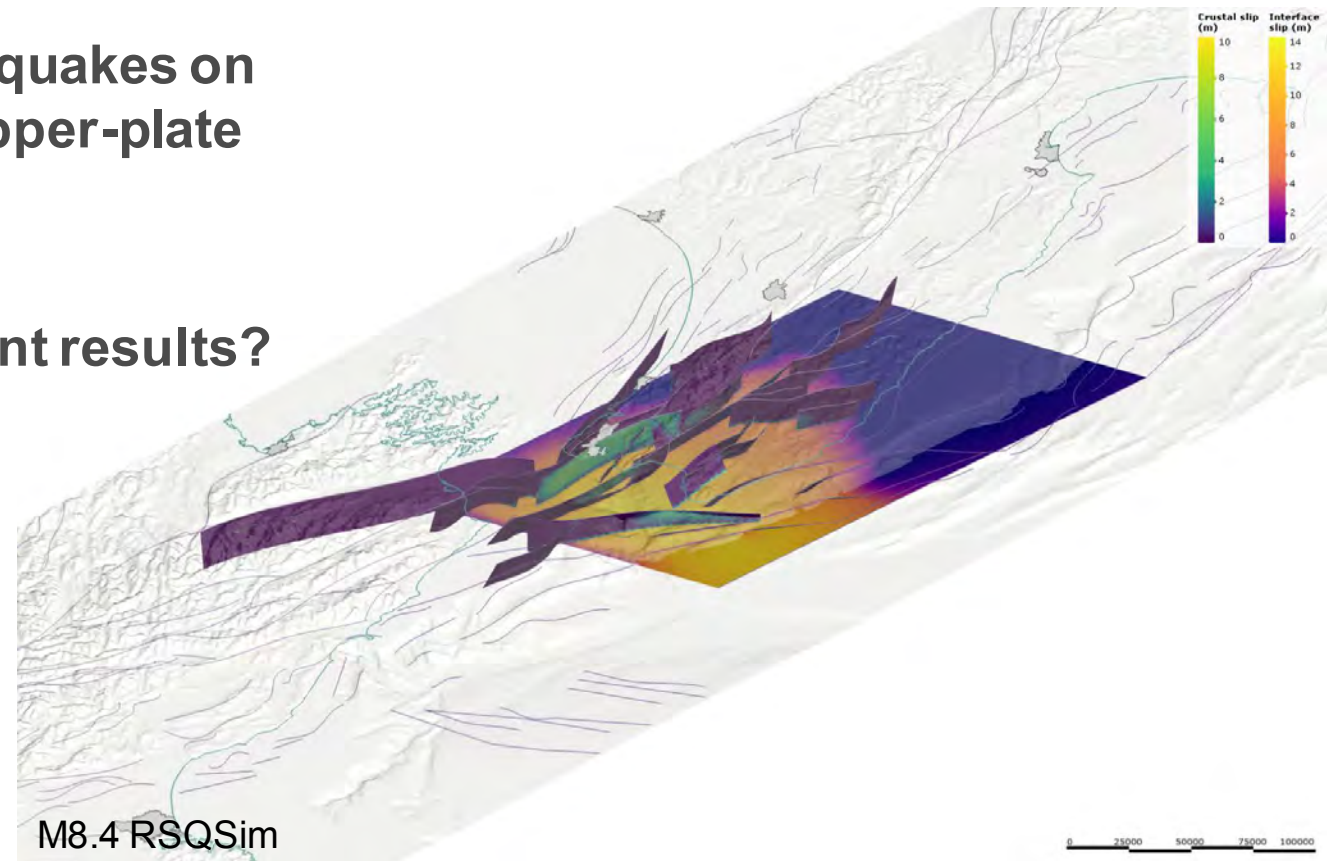
Planning and Policy



- **Planning for Natural Hazards under the National Policy Statement for Urban Development (NPS-UD) 2020**
 - There is provision for managing future development in areas subject to coastal hazards, but emphasis may be on climate change
 - Timeframes are short and may not be enough time to gather information and priority may not be given to lower risk areas
 - A robust risk-based approach will be required
- **Active Fault Guidelines v 2.0 – Proof of Concept**
 - A review of the guidelines is clearly overdue
 - The use of rupture probabilities was explored as an option for revision. Preliminary testing using Wellington faults shows merit but would benefit from more extensive testing.
- **Science to Practice workshops**
 - Lower Hutt (GNS), multiple councils 2019
 - Lower Hutt (GNS), multiple councils Sept 2020
 - Masterton, Wairarapa Councils May 2021
 - Lower Hutt, Hutt City Council June 2022
 - Wellington City, Nov 2022 (next week)

2022/23 Projects – Hikurangi Subduction Hazard

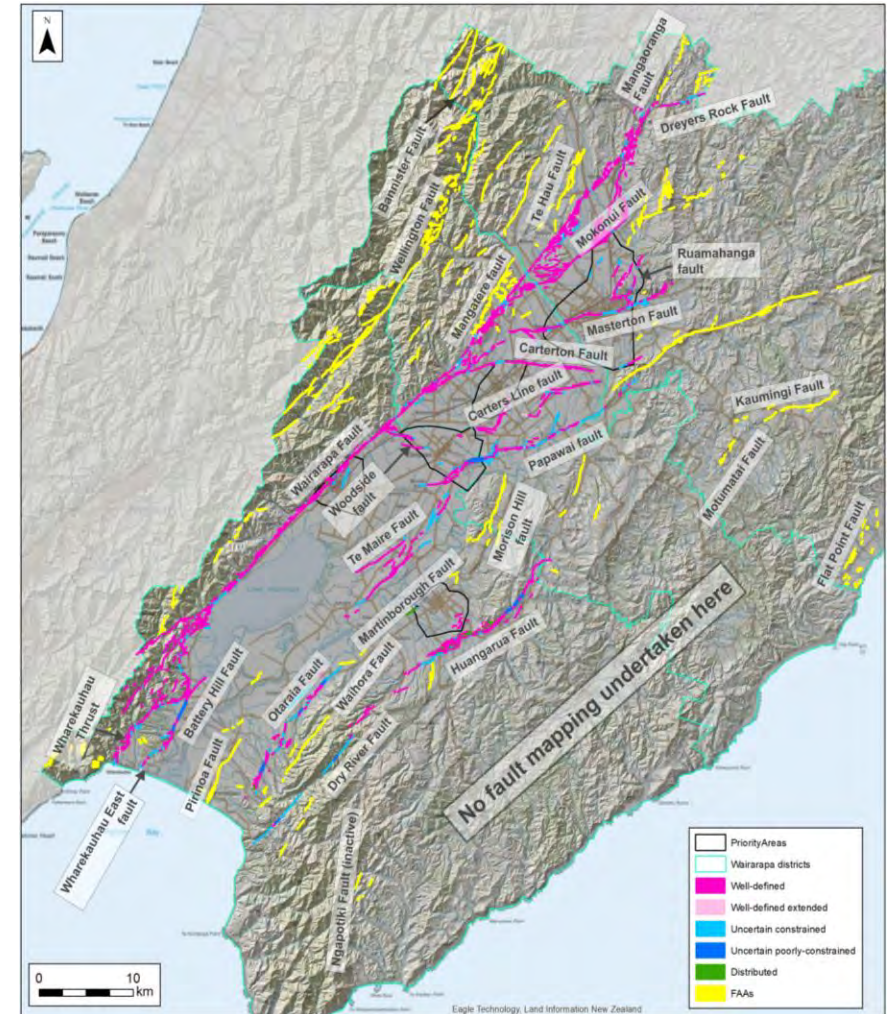
- Coring investigations at Mataora-Wairau Lagoon (with Rangitāne o Wairau) to obtain a longer subduction earthquake record
- Modelling ground motions from earthquakes on the Hikurangi subduction zone and upper-plate faults
- Hui at Kohunui Marae to discuss recent results?



Active fault paleoseismology

Ground-truth and reconnaissance of newly-identified active faults in the Wairarapa mapped for the Draft Combined District Plan

- Ground Penetrating Radar (GPR) transects across 3 of the newly-identified faults near towns
- Selection of sites for future trench investigations
- Iwi engagements



Litchfield et al. (2022) <https://doi.org/10.21420/ZZYW-8698>

Tsunami Hazard and Vulnerability

- Agent-based evacuation modelling for the northern Kāpiti Coast – Peka Peka, Te Horo Beach and Ōtāki Beach
- Impacts on coastal habitats and current coastal vegetation restoration efforts
- Impacts on man-made environments – Mana Marina

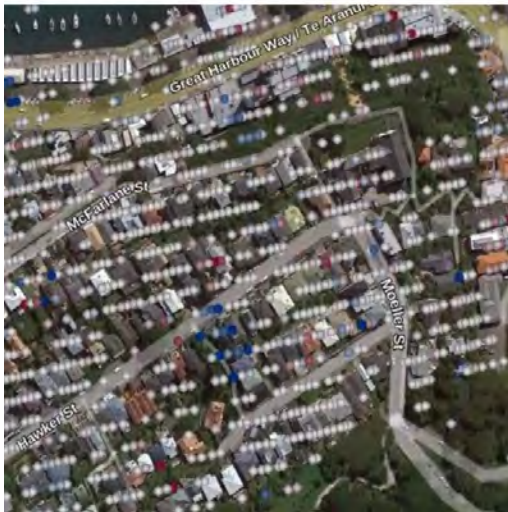
Planning and Policy

- Review Wellington Draft District Plans implementation of NPS-UD requirements in relation to natural hazards to help inform a common framework for the Region
- Science to Practice workshop (Wellington City Council – next week)



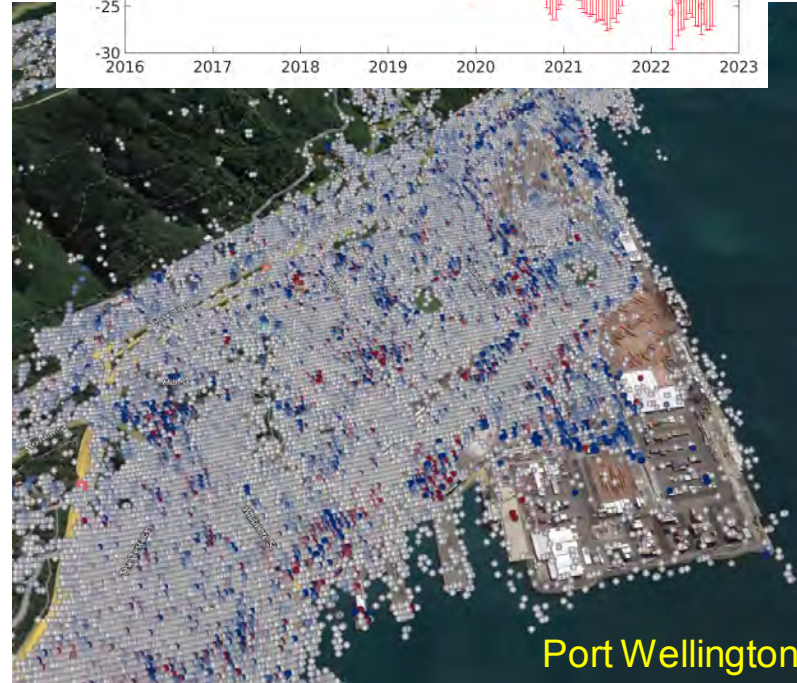
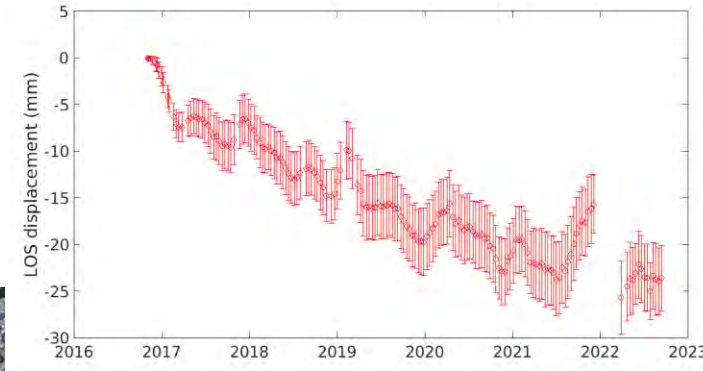
Ground Deformation

InSAR data processed at high-resolution (3 x 14 m) every ~10 days to monitor ground movements

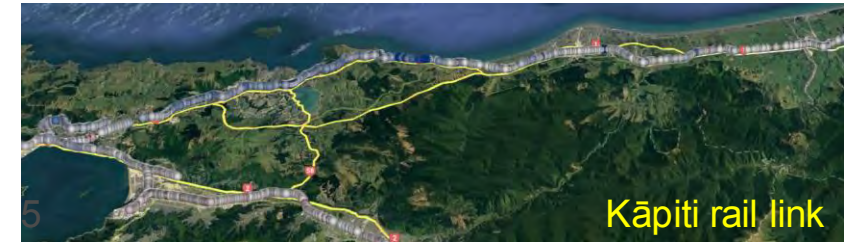


Individual house movement

Mean LOS Displacement rate (mm/yr)



Deformation after the 2016 Kaikōura EQ



Provide early identification of problem regions



<https://www.itsourfault.org.nz/>

<https://www.itsourfault.org.nz/collaboration>