Infrastructure failure propagations and recovery strategies from an Alpine Fault earthquake scenario

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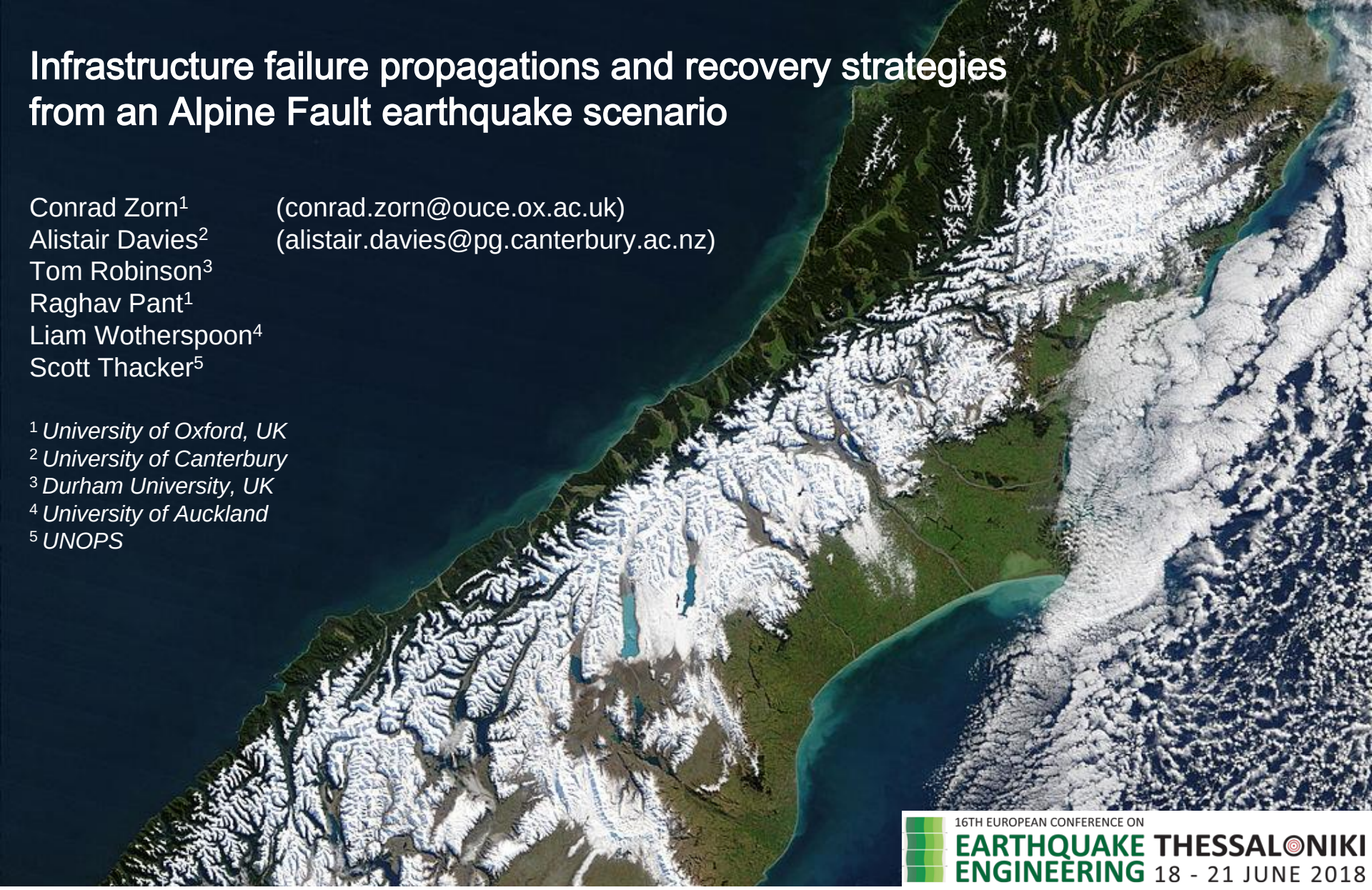

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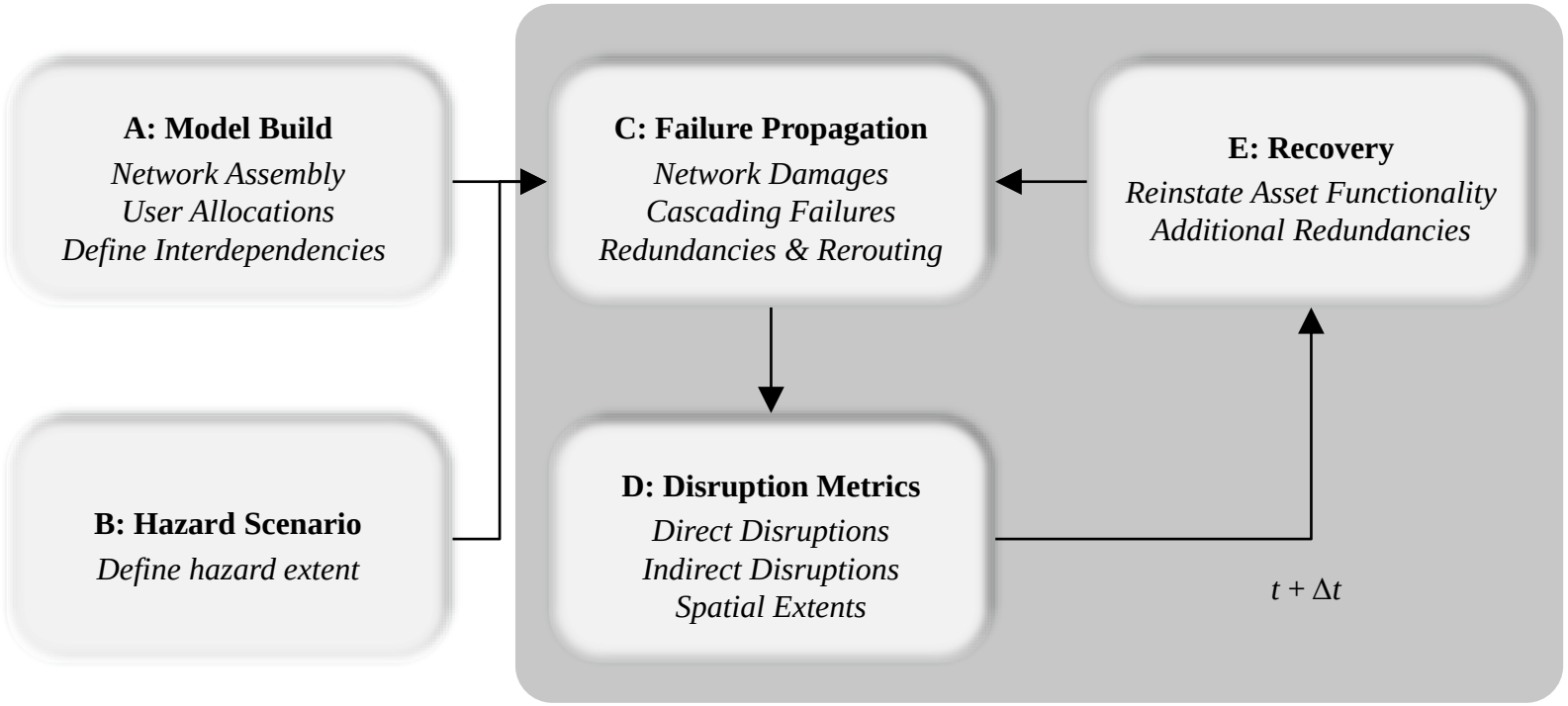
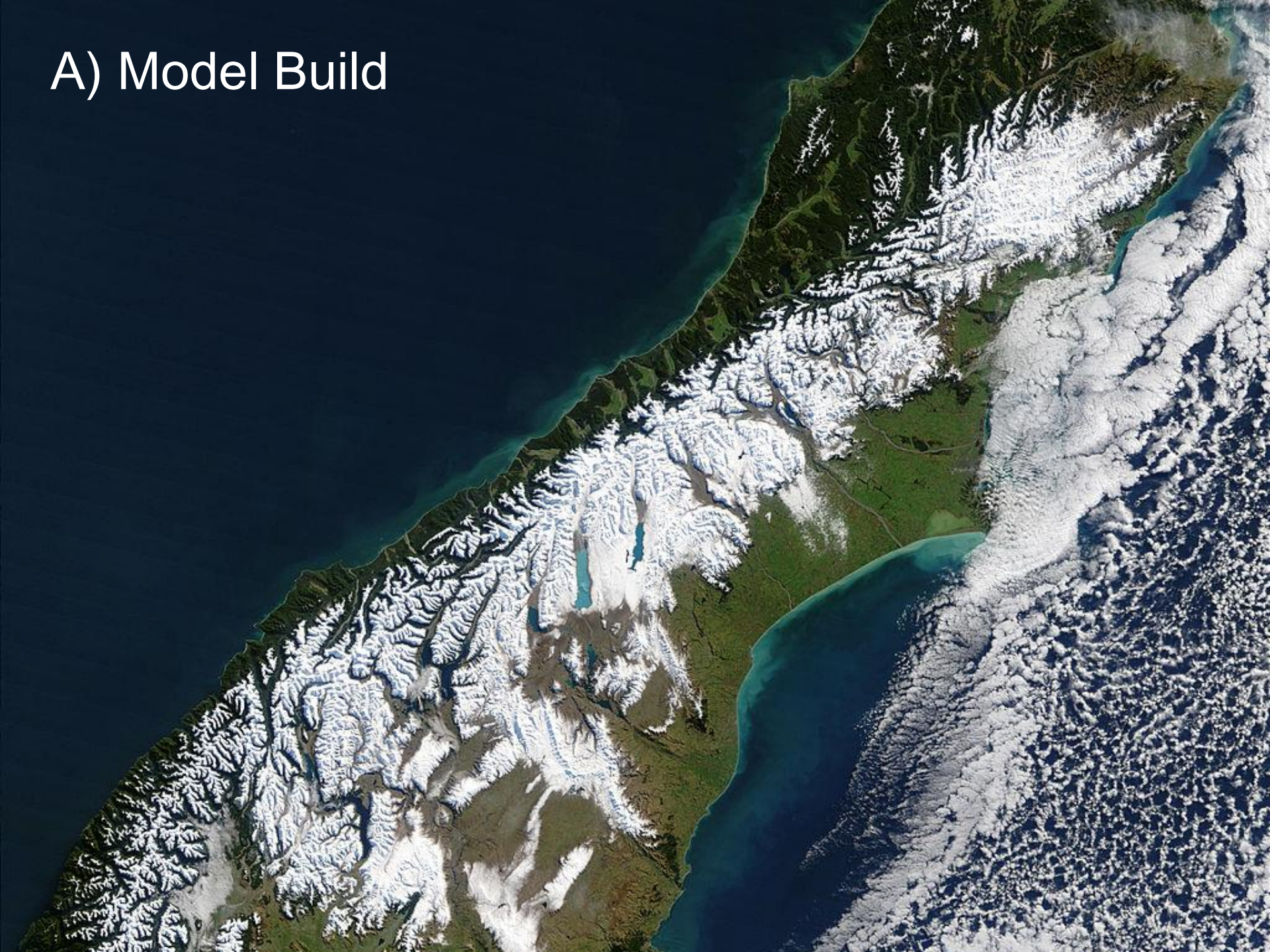
National Science Challenges | rural | hazard | infrastructure | QuakeCoRE NZ Centre for Earthquake Resilience | EQC Earthquake Commission Kōmihana Rūwhenua | AF8 Alpine Fault Magnitude 8 | ITRC mistral multi-scale infrastructure systems analytics

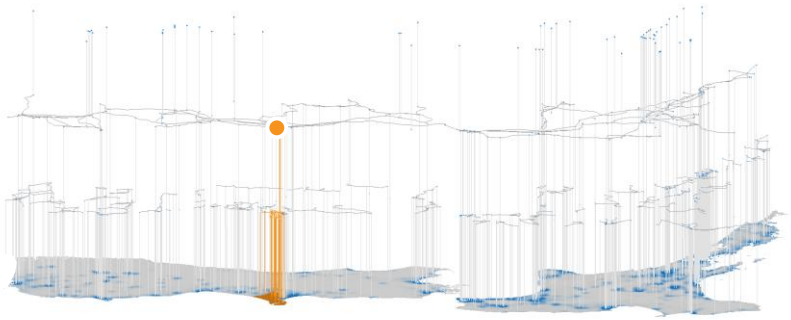
Integrated framework

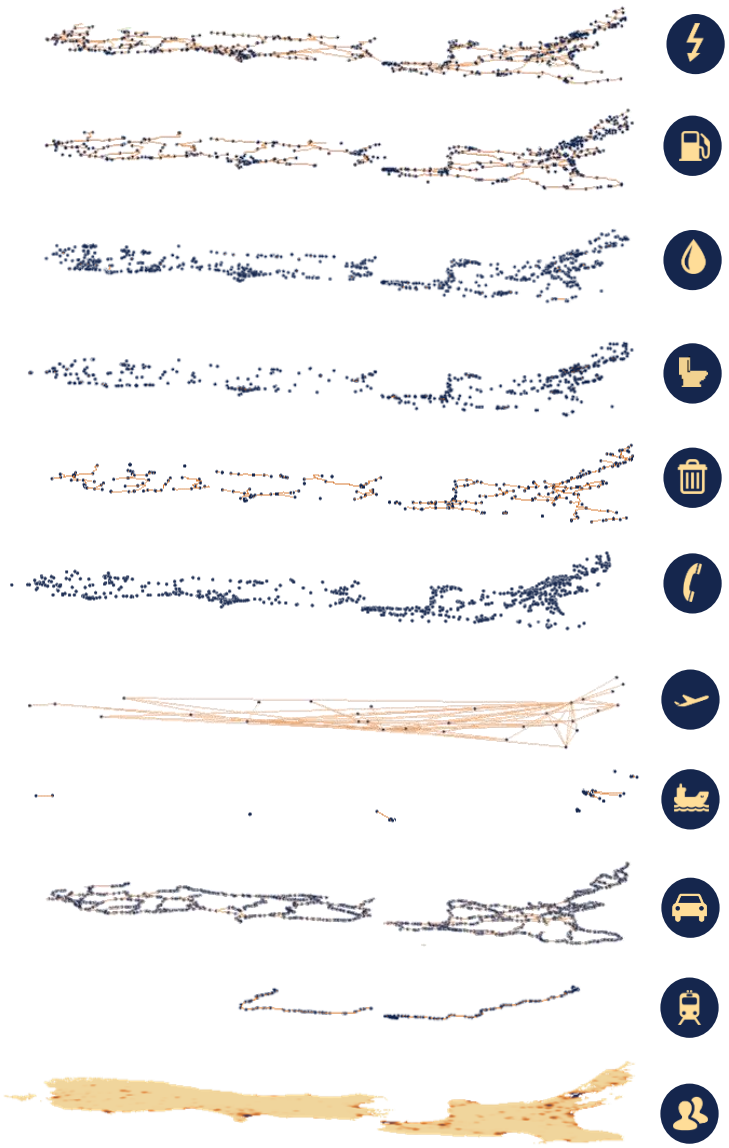


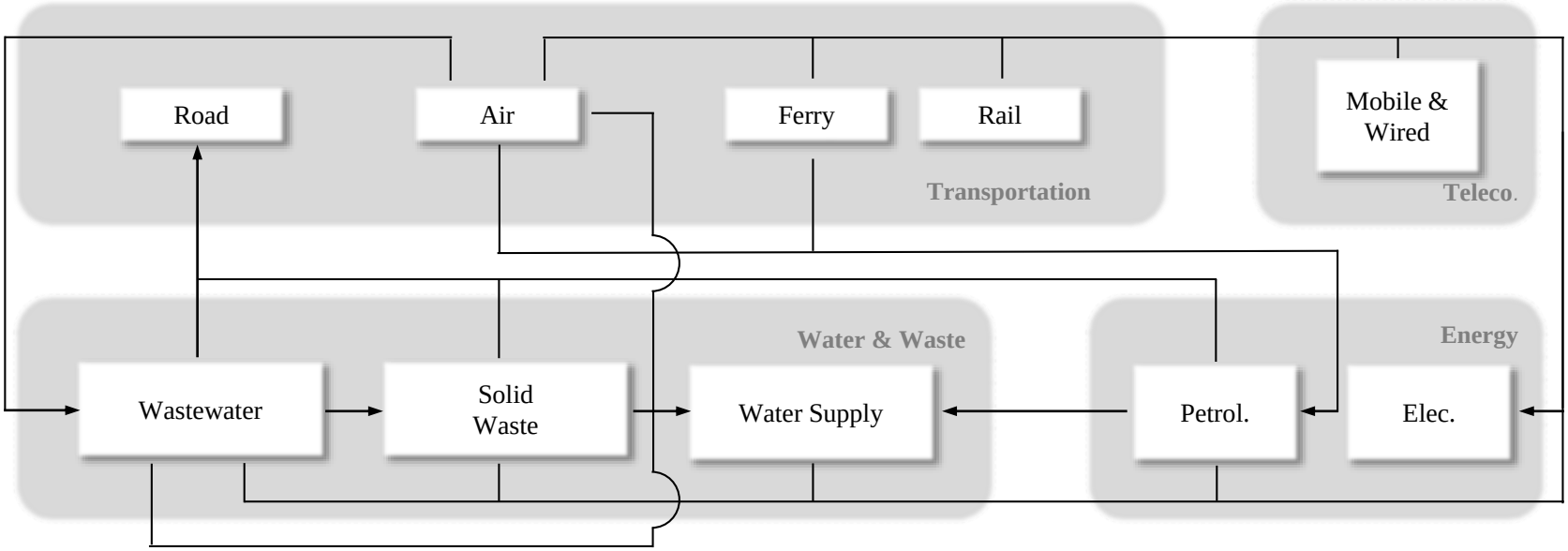
A) Model Build



Sector	Infrastructure	Assets
Energy	Electricity	Generators, Transmission Substations, Distribution Substations, Power Grid
	Petroleum	Bulk Supply Points, Petrol Stations, Delivery Routes
Water & Waste	Water Supply	Sources, Treatment Plants, Pump Stations, Reservoirs, Pipes
	Wastewater	Pump Stations, Treatment Plants, Pipes
	Solid Waste	Transfer Stations, Landfills, Delivery Routes
Telecom.	Mobile	Transmitters, Connections to Exchanges
	Wired	Cabinets, Exchanges, Connections, Undersea Cables
Transport	Air	Airports
	Ferry	Terminals
	Road	State Highways
	Rail	Stations and Tracks






Road
Air
Ferry
Rail
Transportation
Mobile &
Wired
Teleco.
Water & Waste
Energy
Wastewater
Solid
Waste
Water Supply
Petrol.
Elec.

B) Hazard Scenario

The AF8+ hazard scenario

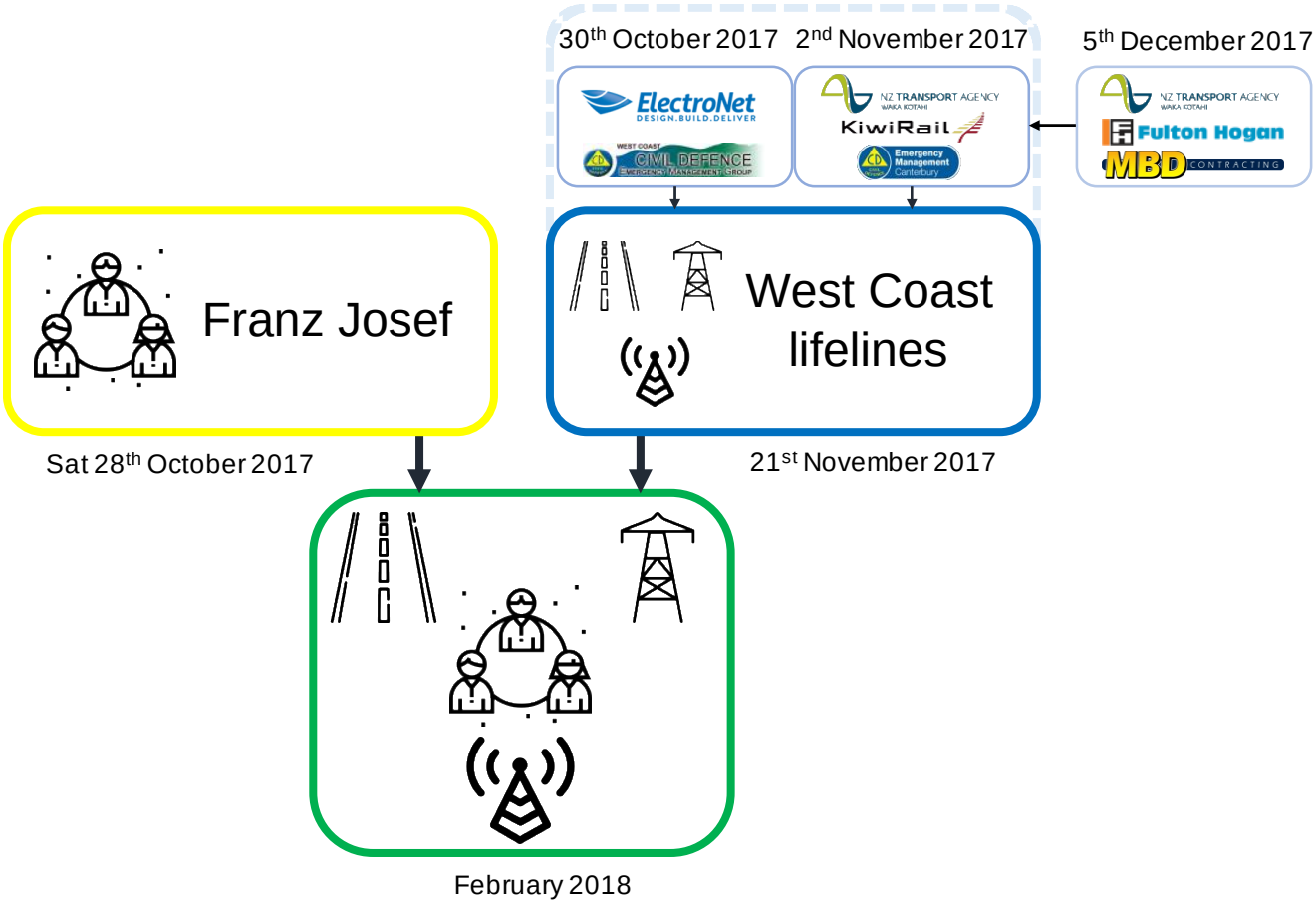
The AF8+ hazard scenario builds on the Project AF8 scenario. The scenario was extended in time from 7 days to 10 years, with the following hazard inputs:

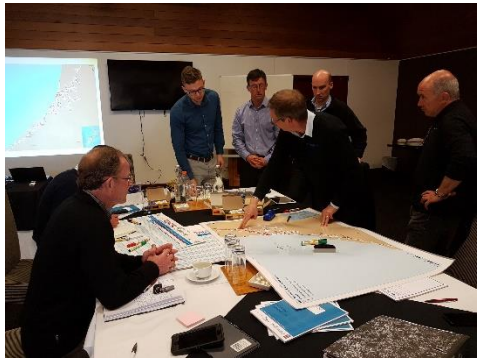
- Earthquake rupture
- Earthquake shaking
- Aftershocks
- Co-seismic landslides
- Rainfall

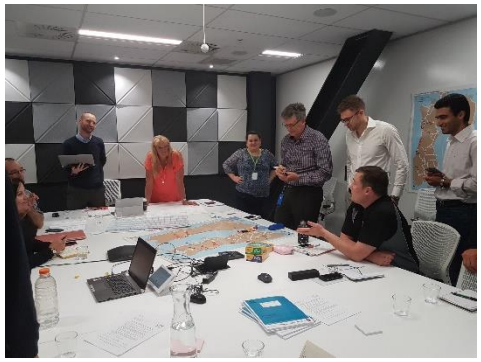
Increasing resilience for potentially isolated communities by improving post-disaster service levels

Improve post-disaster planning

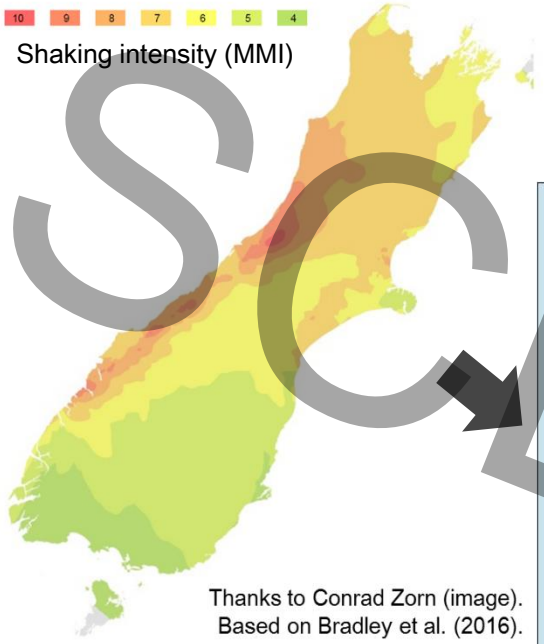
Use a scenario as a boundary object through a series of workshops







1) Modelled shaking is used to model landslides



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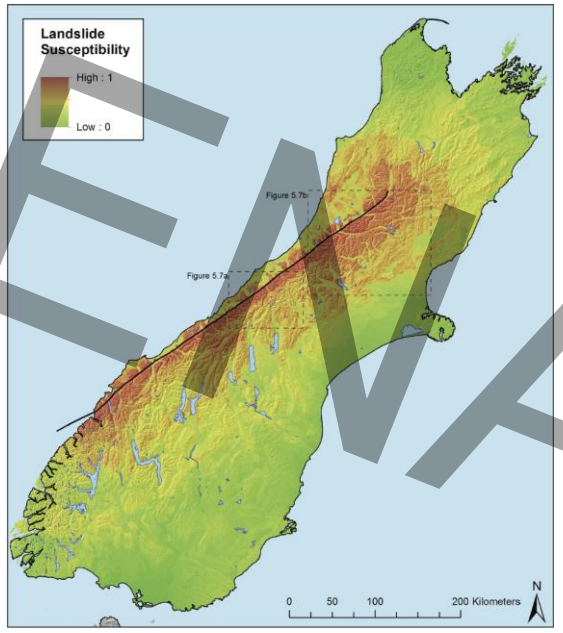
Based on Bradley et al. (2016).



Disclaimer

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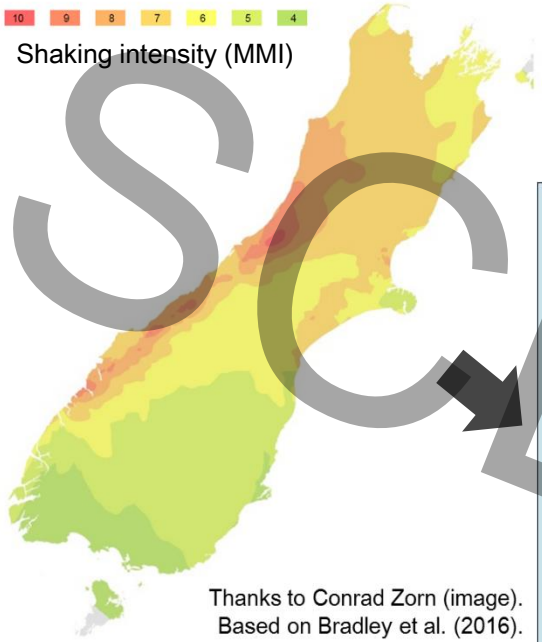
It is vital to understand that the AF8+ scenario is NOT A PREDICTION of what will happen during and after the next major earthquake (which may not be on the Alpine Fault). The underlying philosophy is that if we plan for the extreme case, we certainly improve our ability to cope with less severe events (“expect the worst, hope for the best”). For more information, please contact alistair.davies@pg.canterbury.ac.nz.

2) Infrastructure overlaid to show landslide impacts



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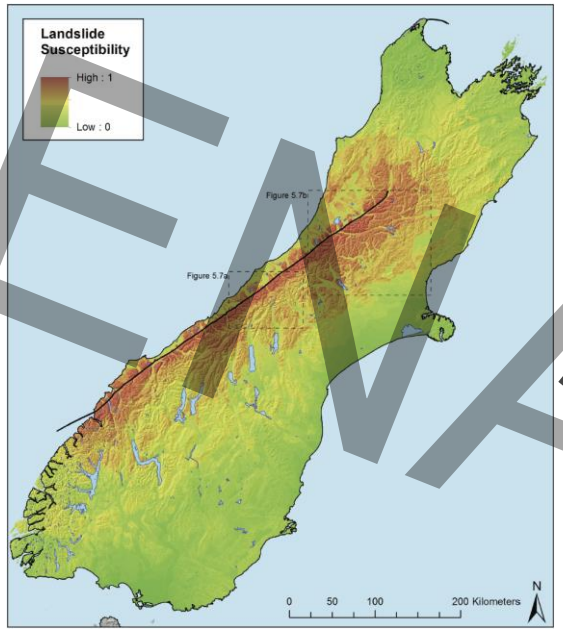

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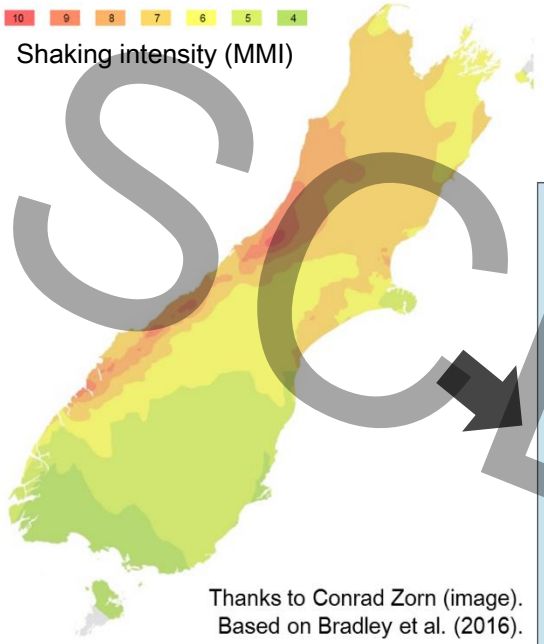
3) In workshops, infrastructure stakeholders used the hazard and impact maps to estimate level of service



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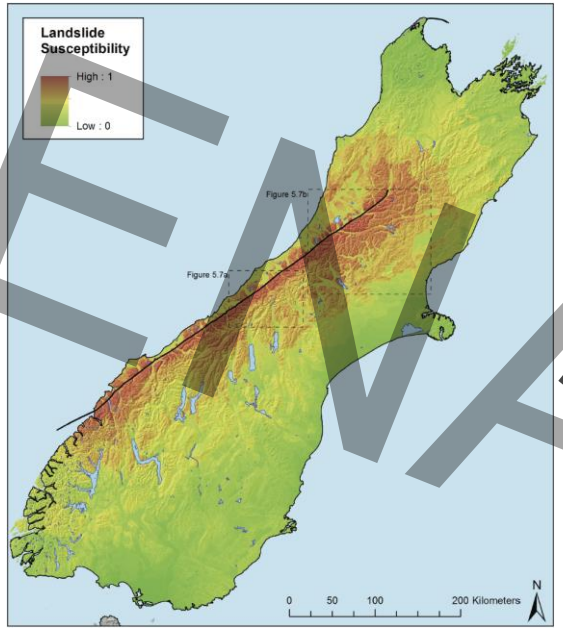

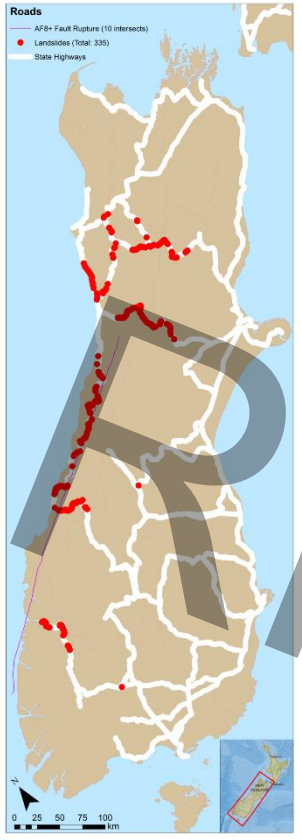

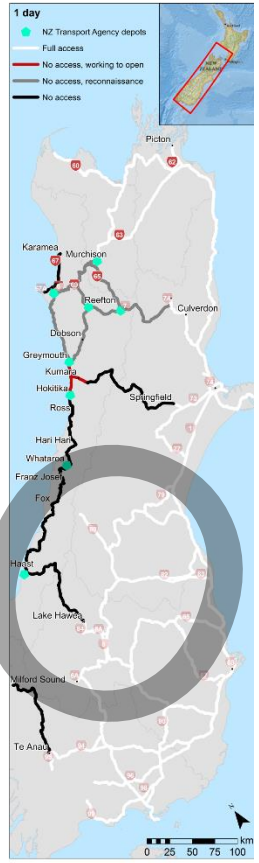

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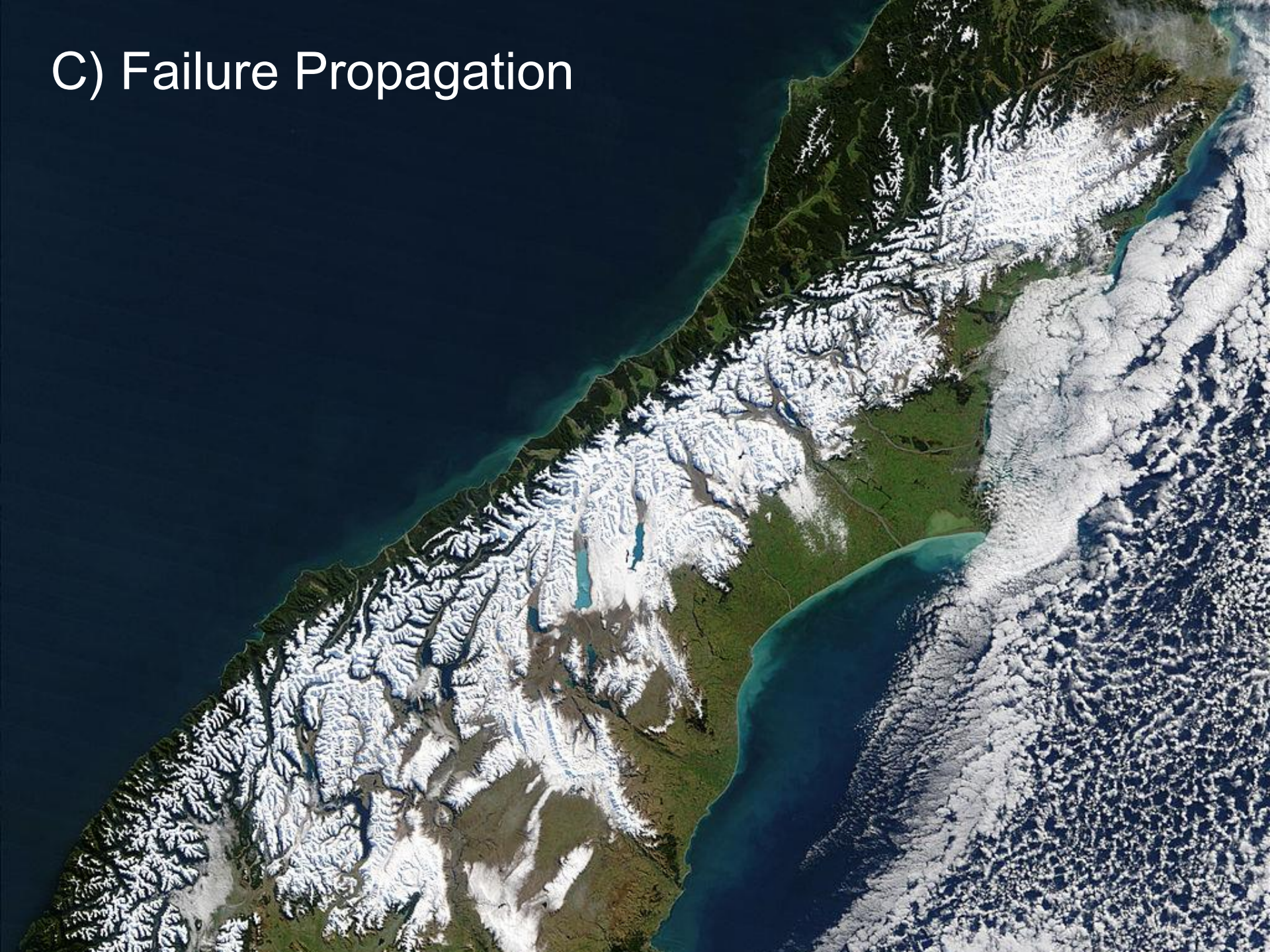
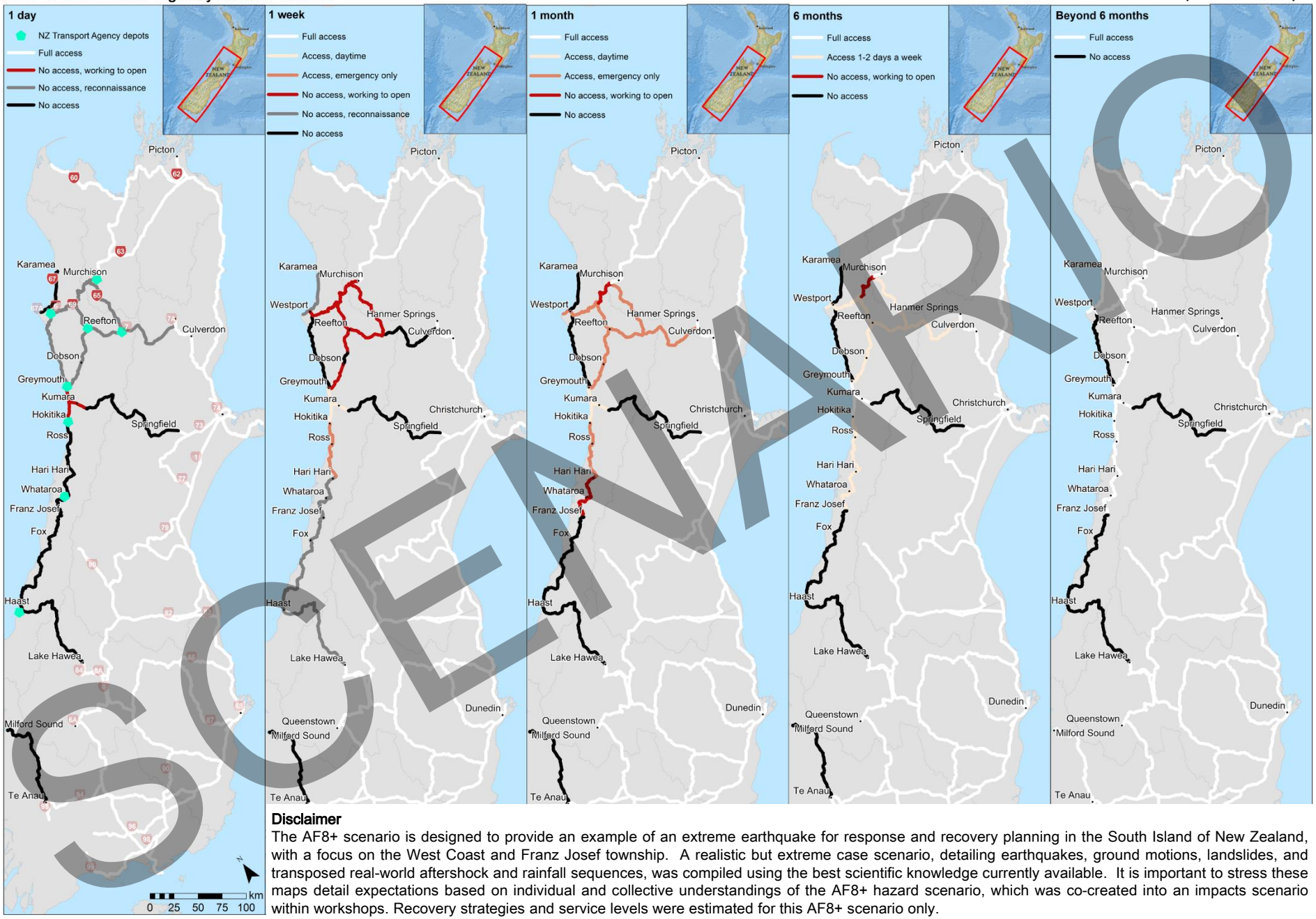
C) Failure Propagation



AF8+ scenario State Highway levels of service

Estimates from transport workshops



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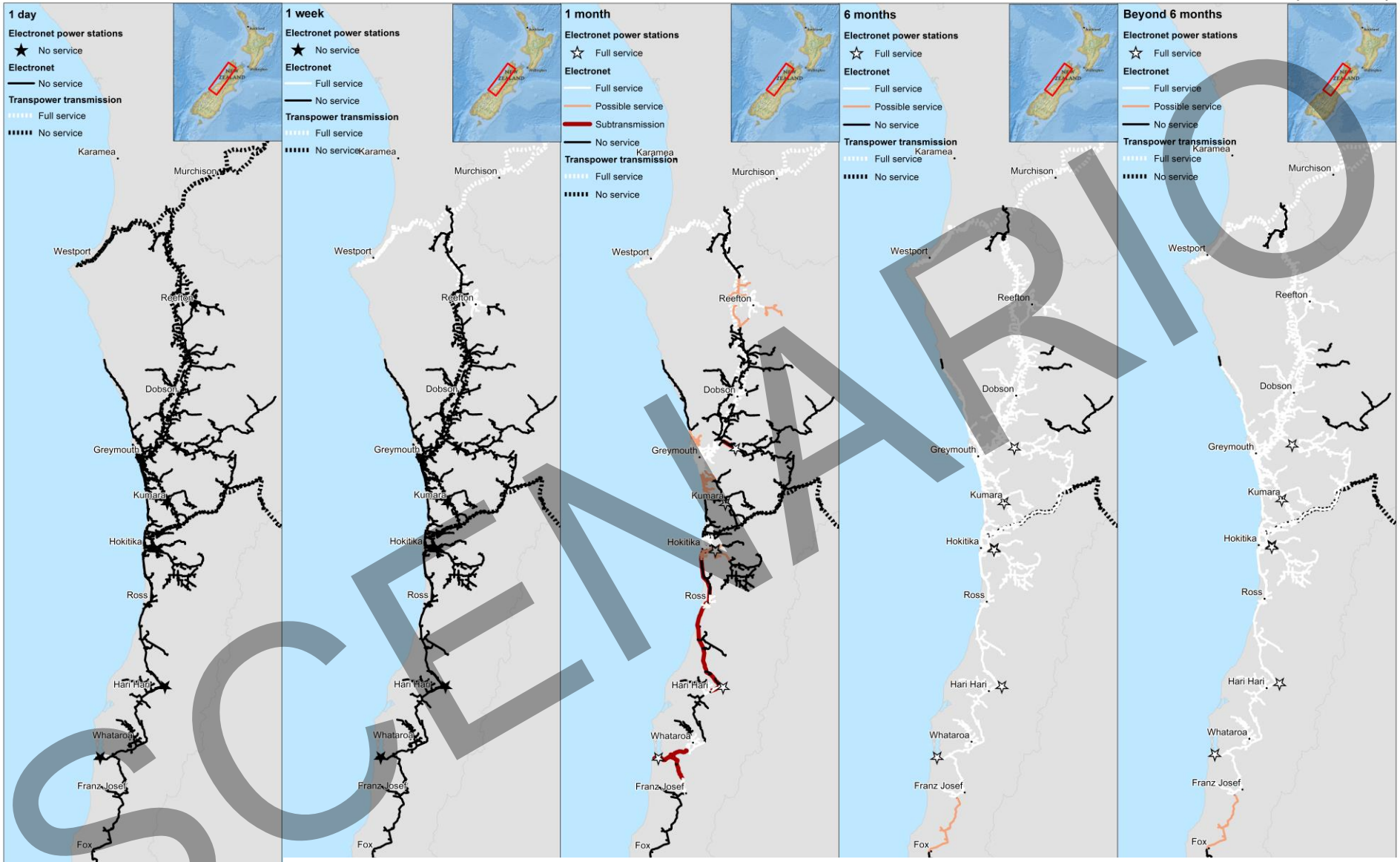
AF8+ scenario Electronet levels of service

Estimates from electricity workshop



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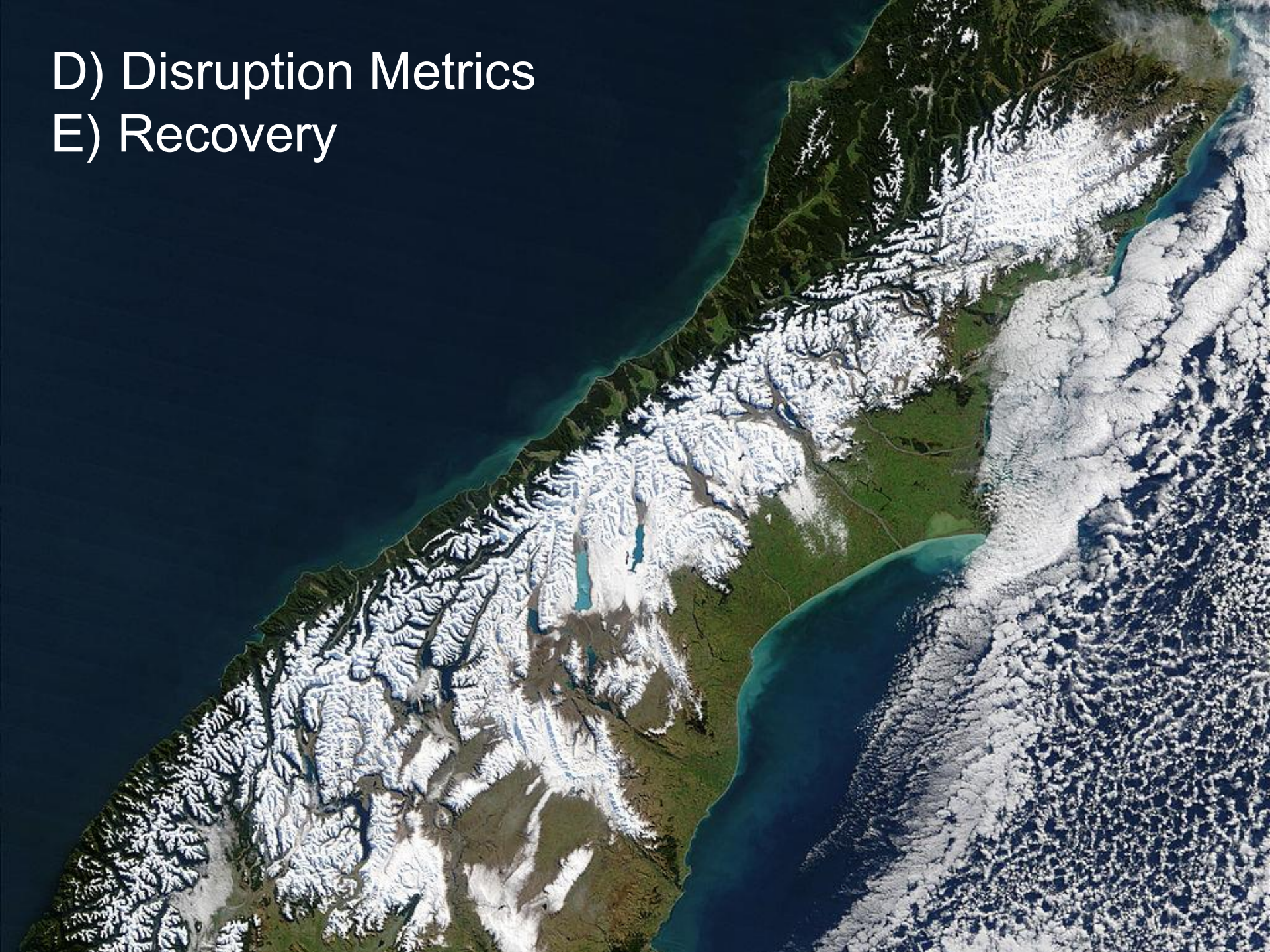
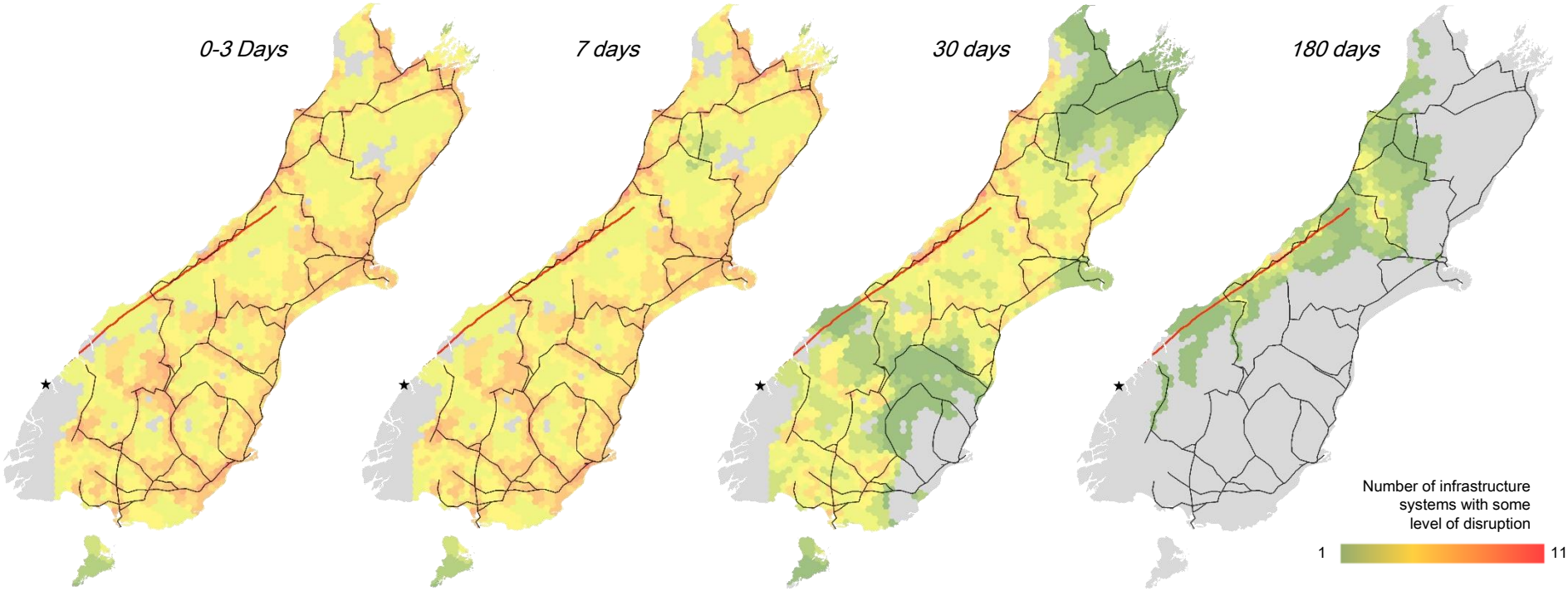
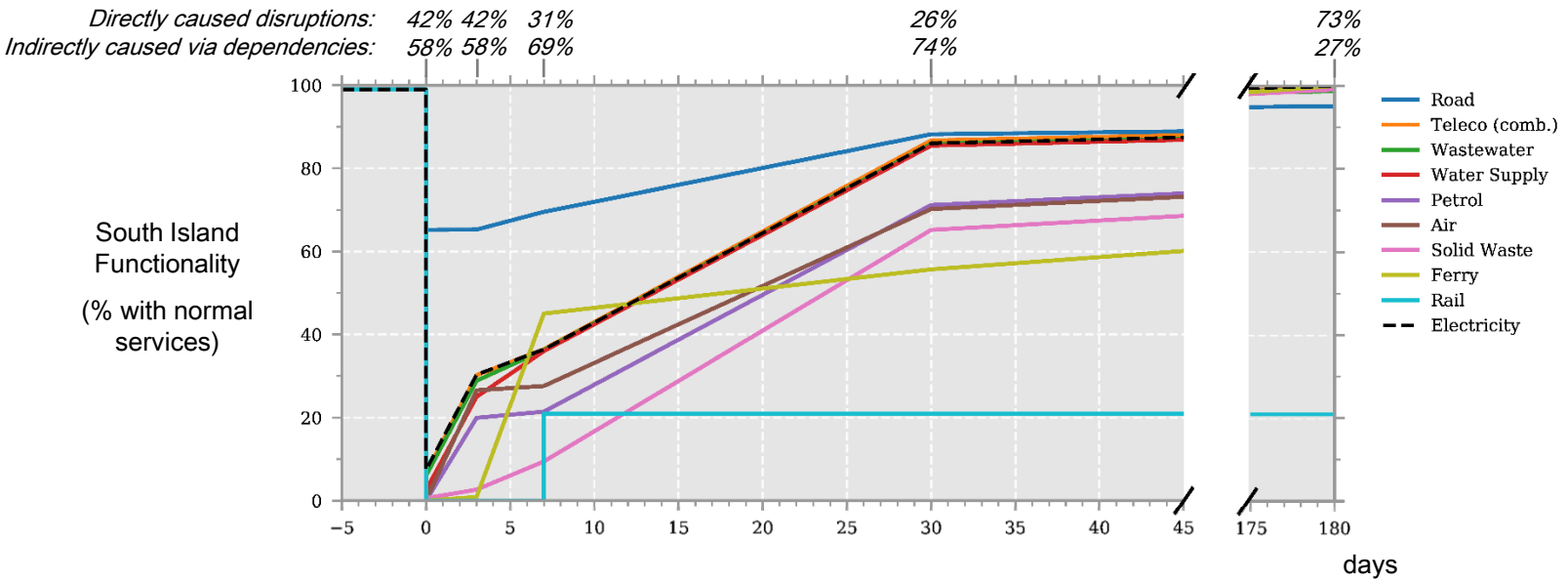
D) Disruption Metrics
E) Recovery




0-3 Days
7 days
30 days
180 days
Number of infrastructure systems with some level of disruption
1
11


Directly caused disruptions: 42% 42% 31% 26% 73%
Indirectly caused via dependencies: 58% 58% 69% 74% 27%
South Island Functionality
(% with normal services)
100
80
60
40
20
0
−5
0
5
10
15
20
25
30
35
40
45
175
180
days
Road
Teleco (comb.)
Wastewater
Water Supply
Petrol
Air
Solid Waste
Ferry
Rail
Electricity

Future work

- Lifeline providers highlighted road dependency over electricity dependency.

  → Adopt ‘dynamic’ dependencies throughout stages of recovery – how to define, weight, and model these?

- End-to-end disaster preparedness assessment has substantial merit.

- Formal linking of hazard models would improve workflows.

- Infrastructure sector model improvements would also provide benefits.

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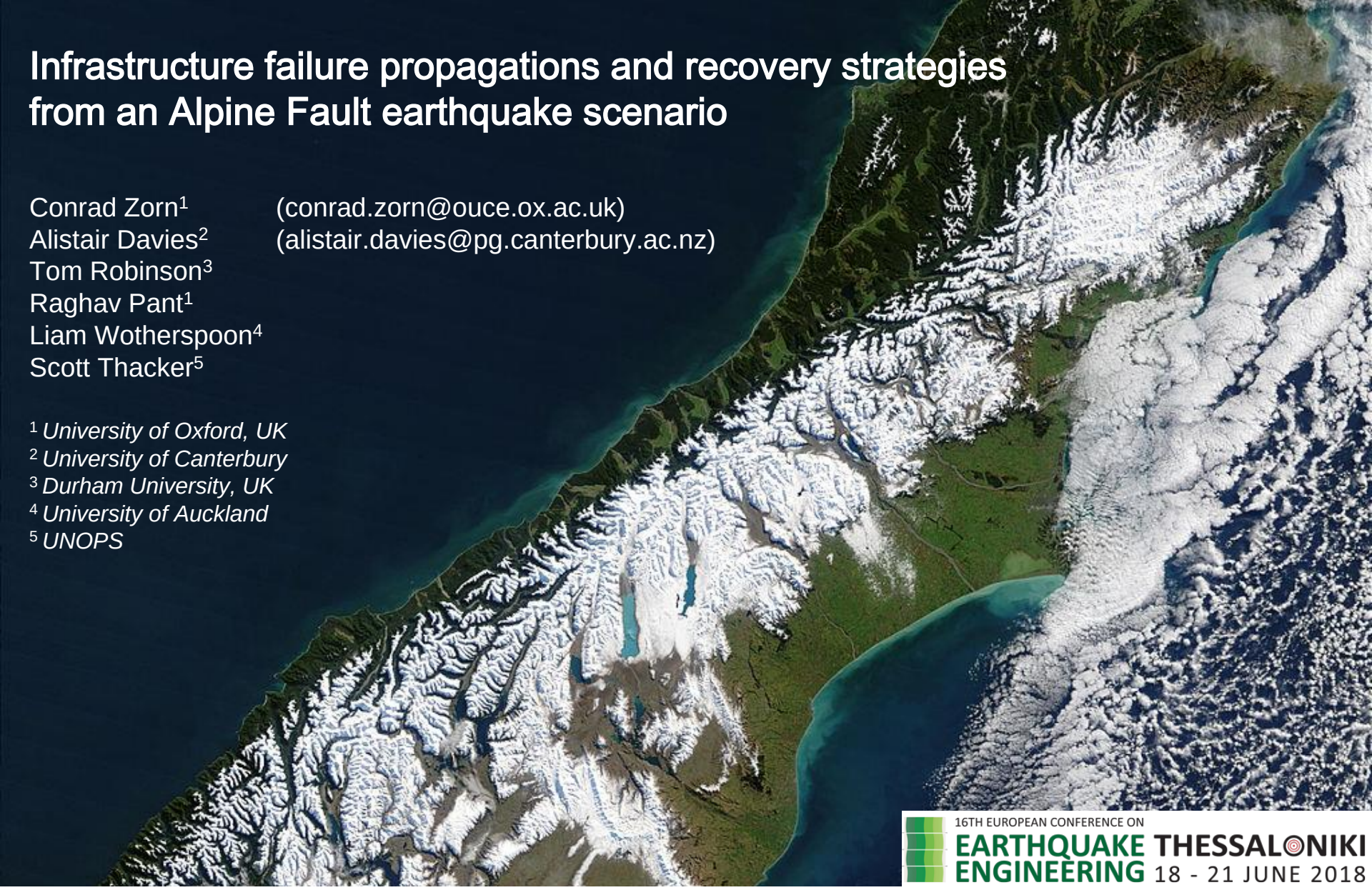

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