Sectoral and Social Benefits of Earthquake Early Warnings (EEW) for New Zealand

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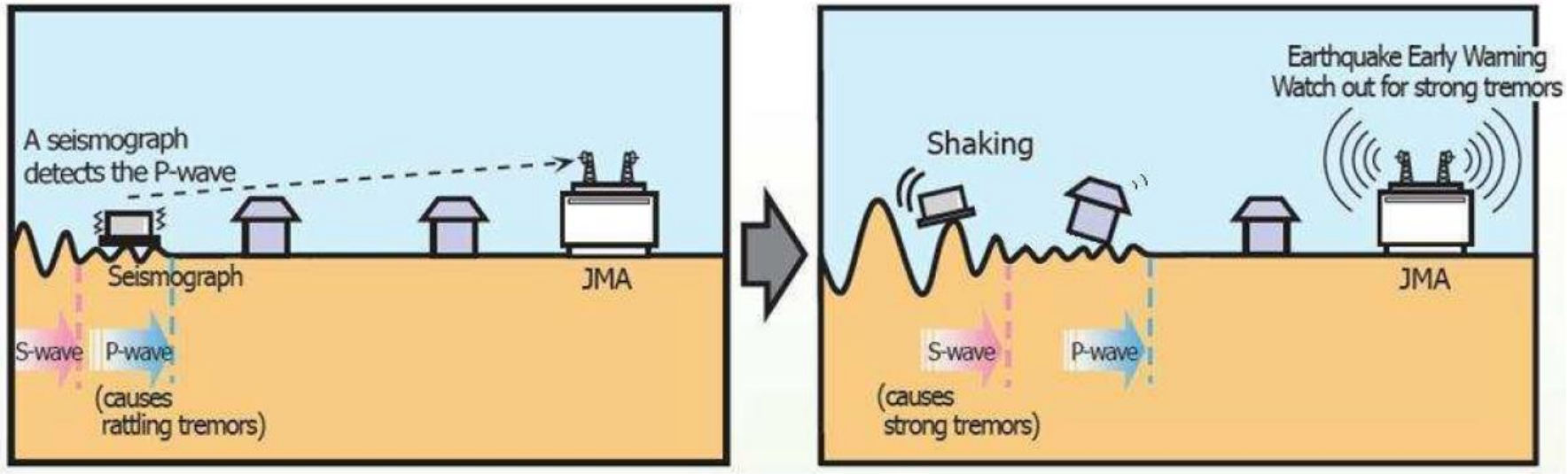
What is an Earthquake Early Warning?

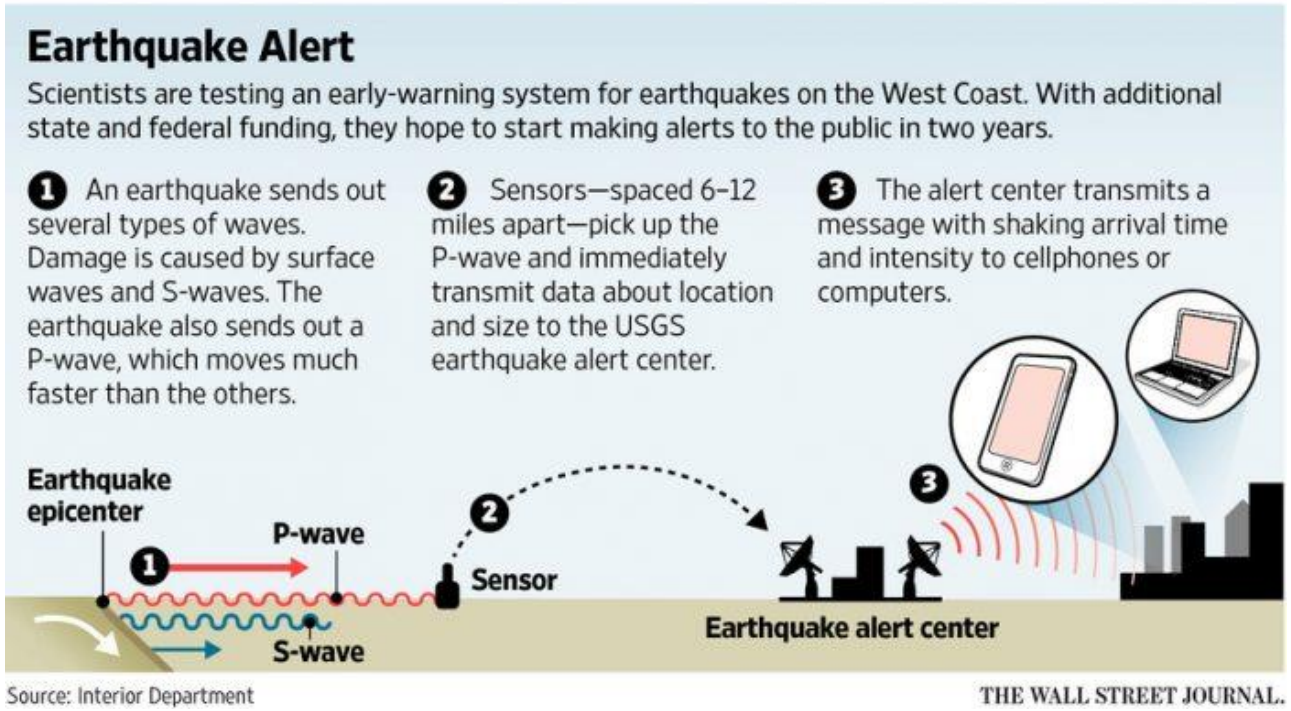
An earthquake early warning is a warning you might get a few seconds to a minute before shaking occurs.



How is a warning generated?

There are two methods of generating a warning:

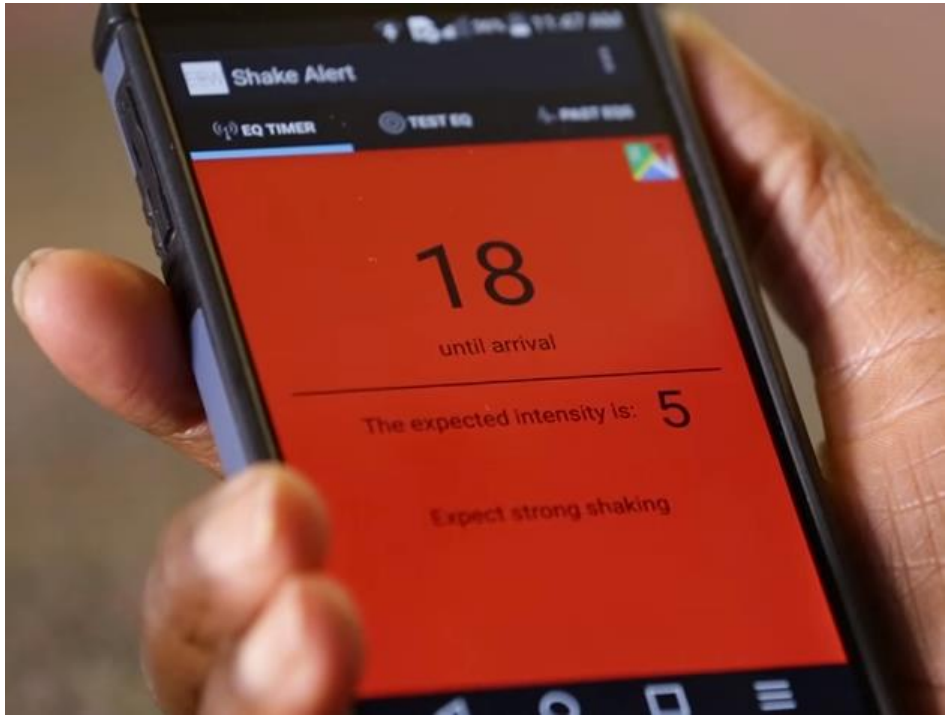
1. By detecting shaking at or near the earthquake source, and sending advanced notification of shaking to other locations
2. By detecting the arrival of the faster P-waves before arrival of the shaking S-waves, and sending out advanced notification of shaking to other locations.



How much warning time do you get?

It depends on:

- The sensors available to detect the shaking or P-waves
- How close you are to the source of the earthquake
  - In some cases you might get no warning before shaking if you are close to the source
  - In other cases you might receive up to a minute or more warning



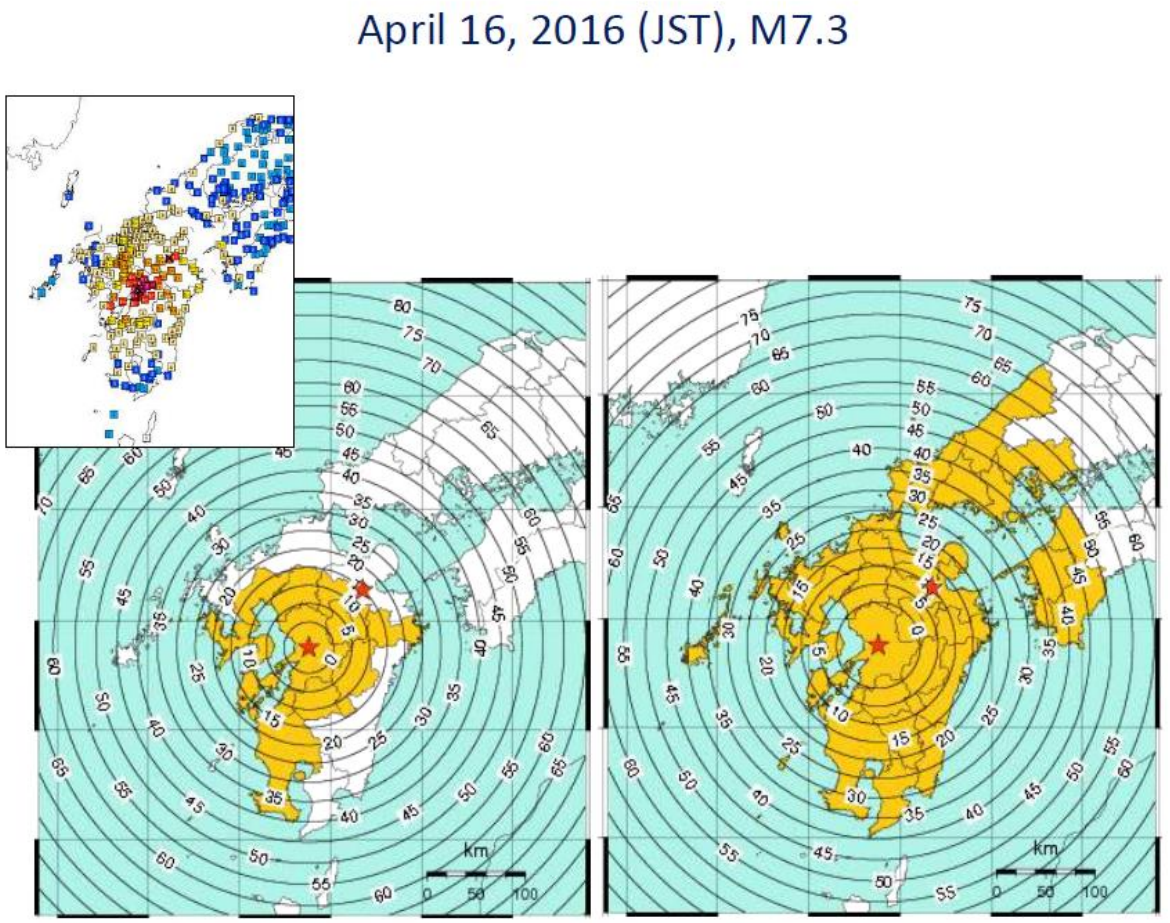
Note that the warning might say, e.g.,

'Earthquake early warning. Prepare for strong shaking'

without counting down the time or showing the expected shaking intensity

What strength of shaking might you receive?

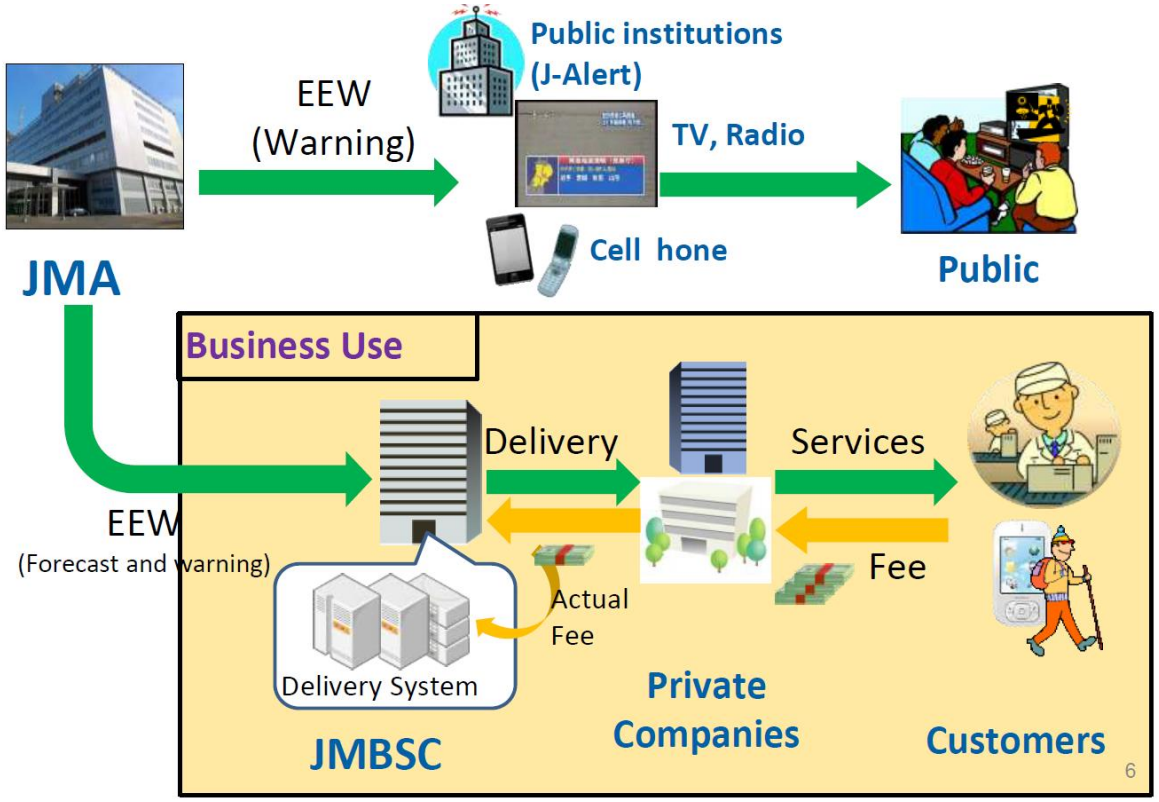
- Closer to the source the warning time will be shorter, but the shaking more intense
- Further from the source the warning time will be longer, and the shaking less intense.



Kumamoto, Japan, 2016 (second earthquake, with Japanese intensity 6/7 at the centre)

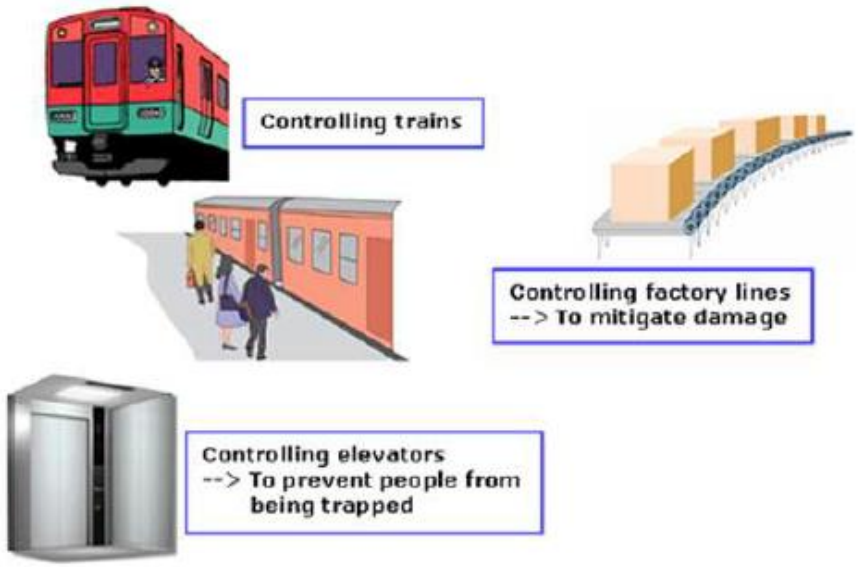
How is a warning disseminated?

- Need thresholds for sending out a warning (e.g. Japanese Intensity 3 for technical users; 5L for public).
- Need a ‘structure’ in place for how receipt and delivery of a warning would occur (e.g. such as in Japan with the Japan Metrological Agency, J-Alert, media, warning areas, etc.).
- Warnings may be transmitted via specific channels such as smartphones, other media devices (e.g. television, radio) or custom-made equipment (e.g. in-house alerting device, siren).



Uses of early warnings

- Automated functions
- Procedural actions



Systems around the world

- Japan
- Taiwan
- Mexico
- US ShakeAlert system (under development)

Evacuation in response to EEW siren in Mexico, May 2016
Photo Credit: Daniel Blake

NZ Earthquake Early Warning System Project

- New Zealand does not have an Earthquake Early Warning System (EEWS).
- Before investing in this technology we want to understand the social benefit of EEWS, and reasons why a warning might not be effective.
- Such information will help us decide whether or not to implement an EEWS.

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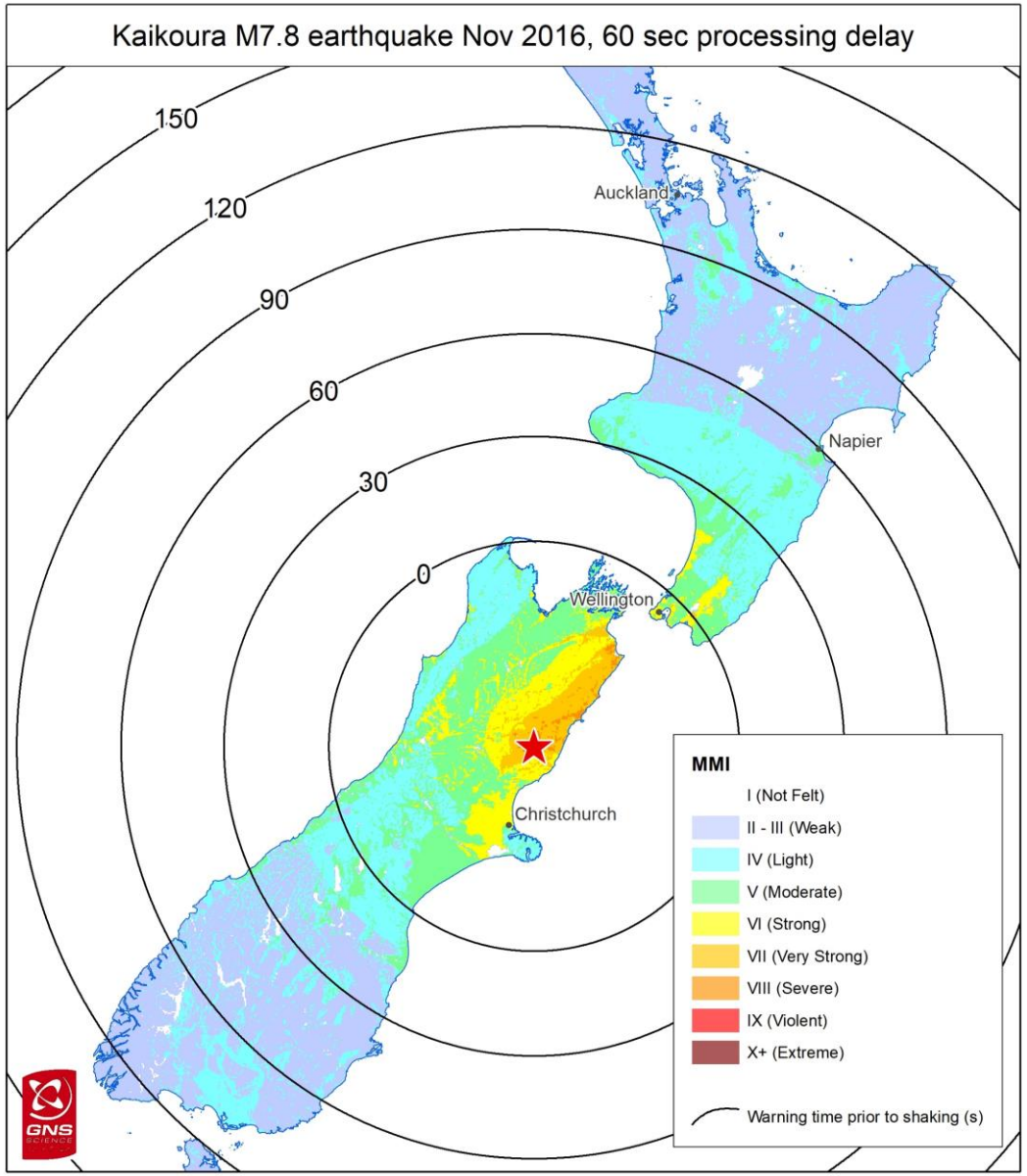
THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

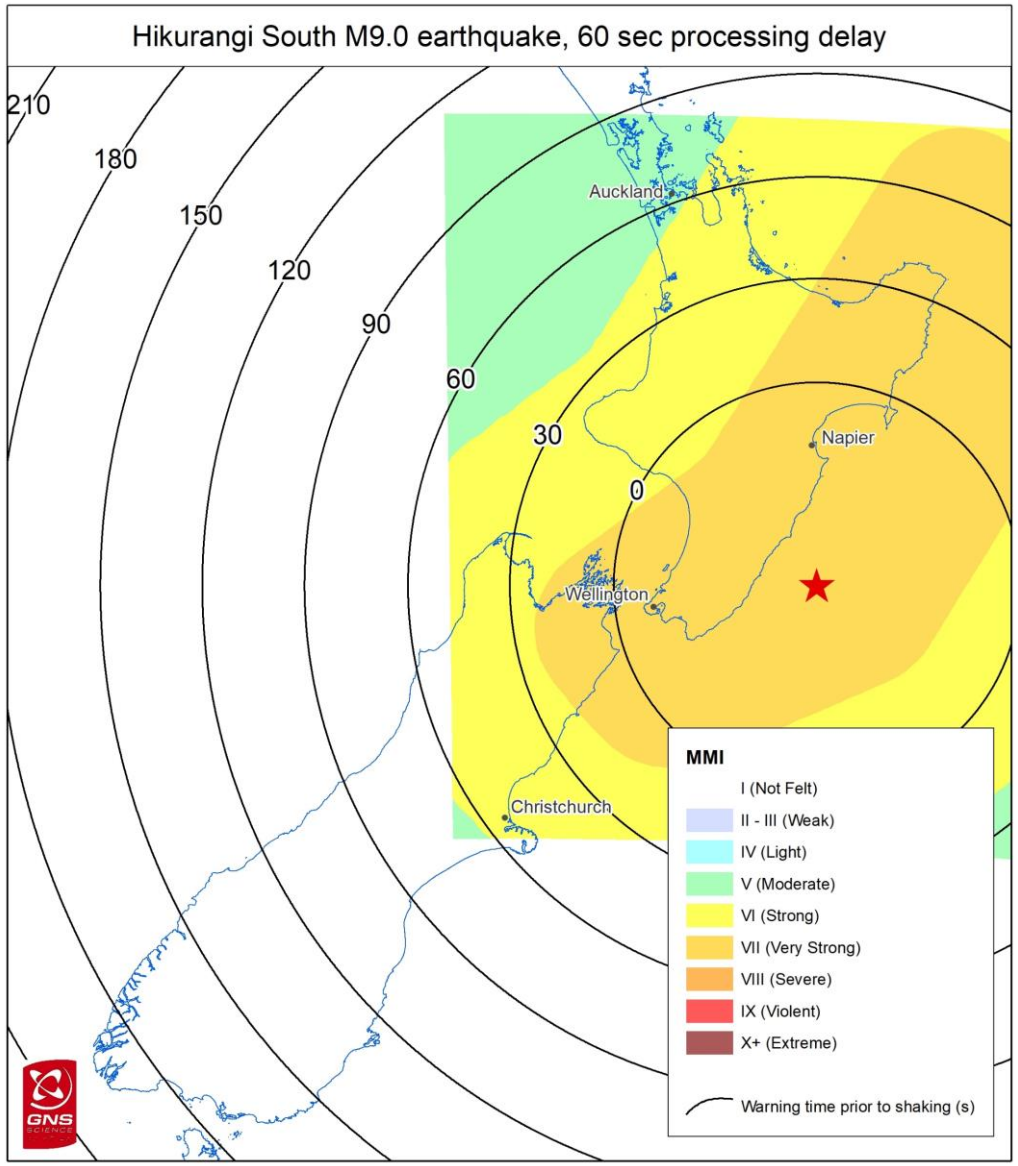
Research approach

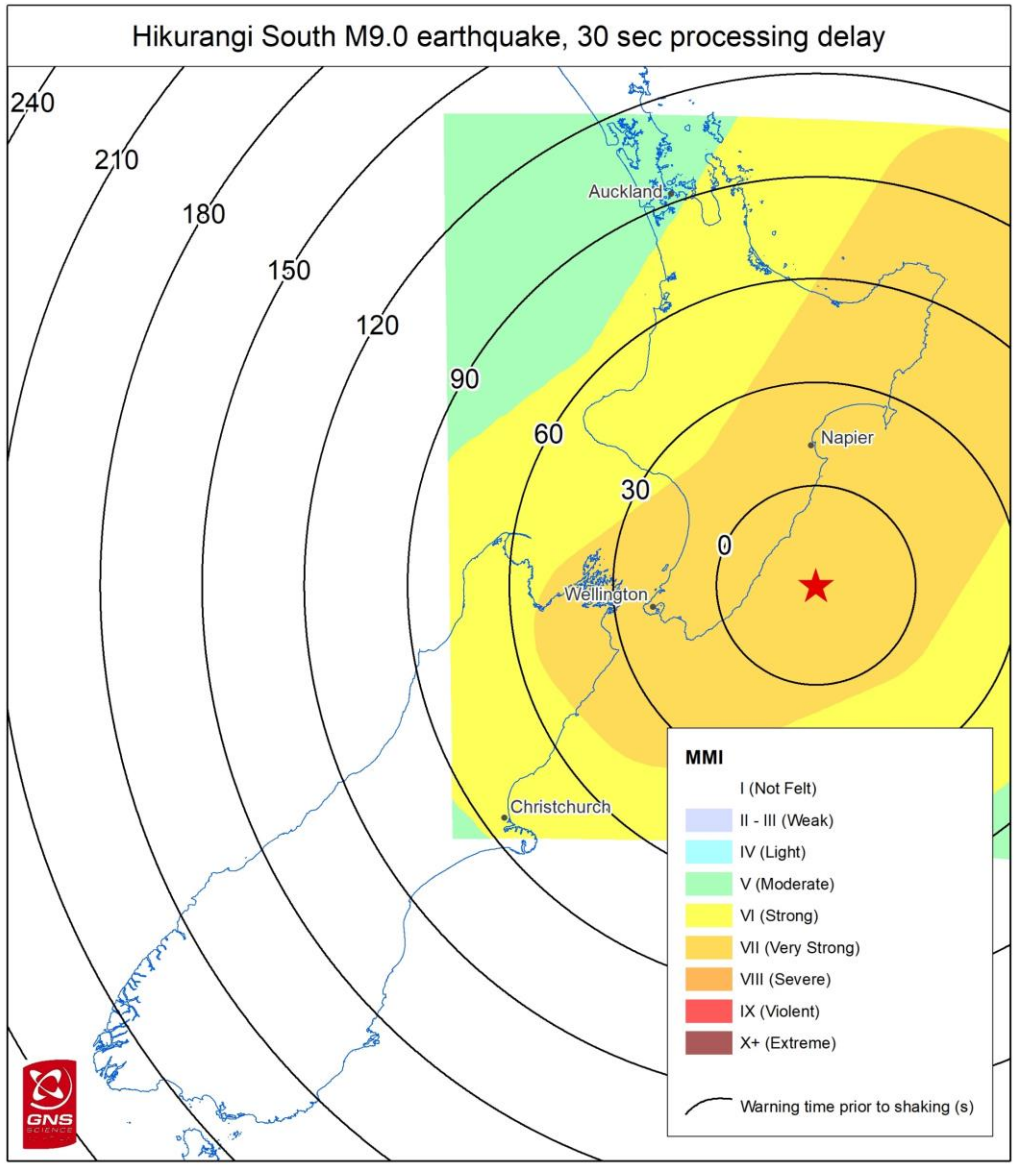
1. Identify regions most likely to benefit from an EEWS (via scenarios)
2. Determine benefits of EEWS for key sectors (via focus groups).
3. Investigate likely responses by the public on receipt of EEW messages (via surveys in NZ and Japan).
4. Synthesize and report the results.



Kaikoura Earthquake, 60s proc

Use of scenarios to identify regions that would benefit





Sectoral focus groups

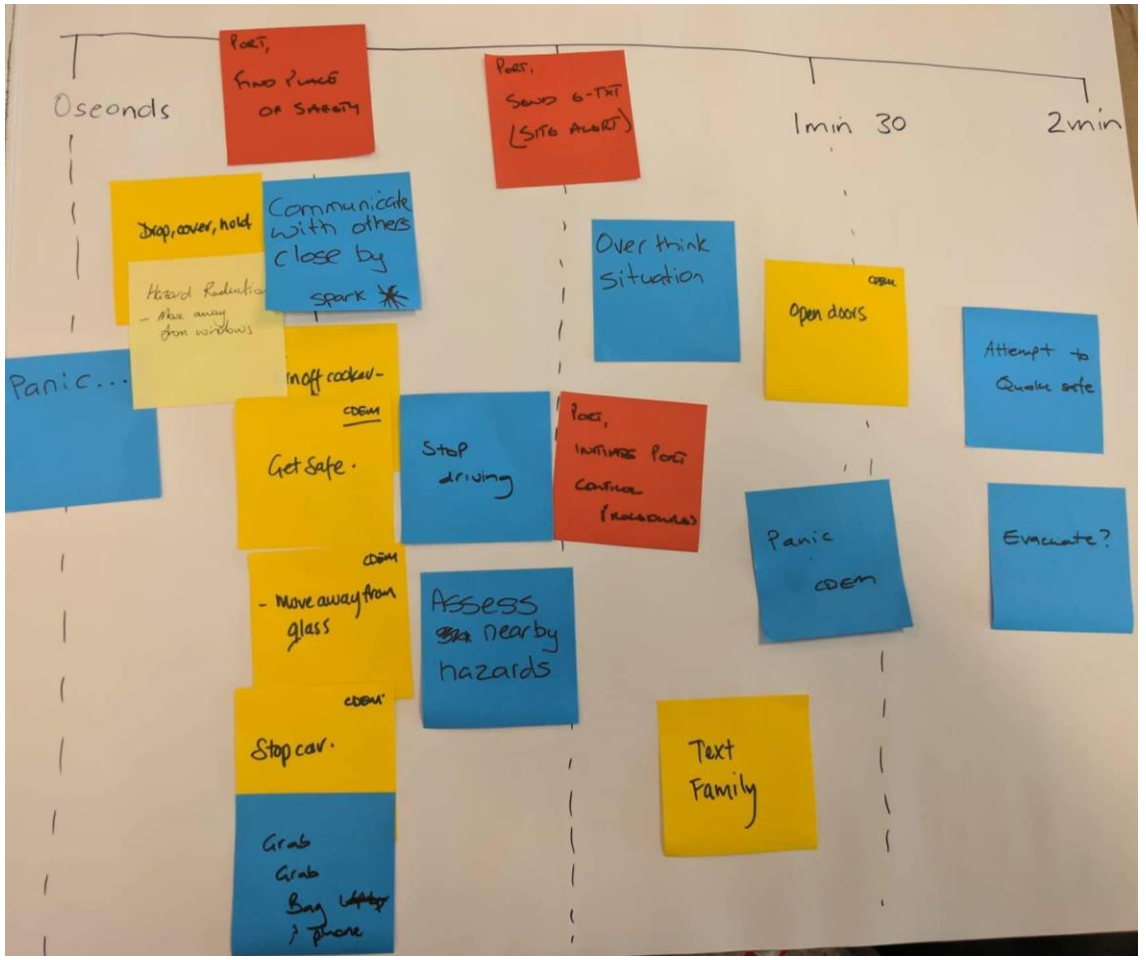
- Wellington, Christchurch, Napier, Auckland (July-August 2018)
- Supplemented by four interviews
- Cross-sectoral but with a few sectors missing (education, rail)
- Questions about:
- Anticipated use of EEW
- Desired mechanisms and messages
- What sectors would do with different warning times and levels of MMI
- Benefits and challenges

Some themes we are already seeing:

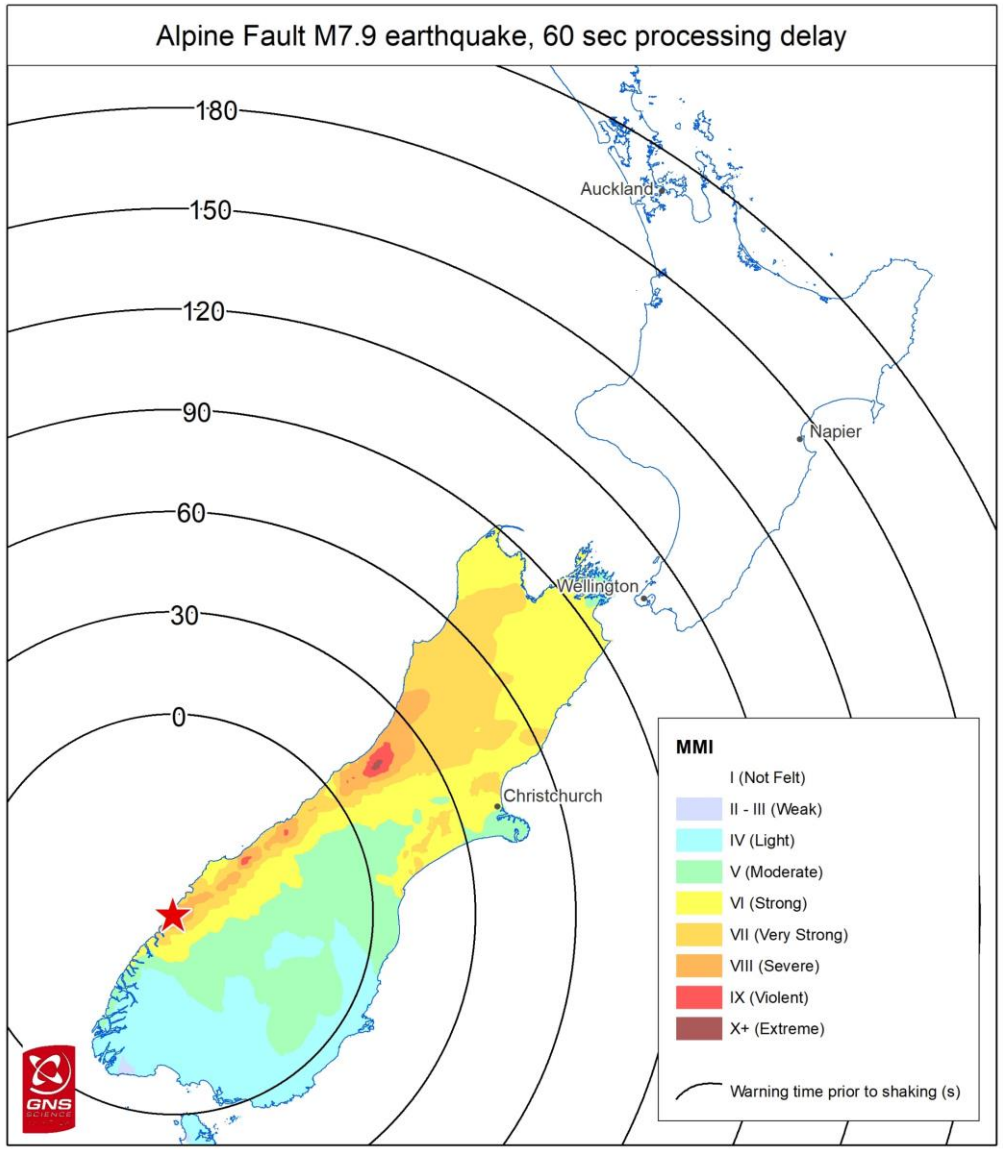
- Main perceived uses are for health and safety (incl. Drop, Cover, Hold) and mental preparedness. A few people thought EEW could be used to switch off specific functions in their sector either automatically or manually, but a number have also said they didn't think it would be worth it (e.g. because they are annoying/difficult to switch on again later).
- Appear to be some variations across sectors and locations in terms of information needs (e.g. MM levels) and thresholds for warnings (e.g. MM 5-7).
- Need for consistent messaging with national messages (e.g. Drop, Cover, Hold).
- Need for integrated warnings/messaging with other perils like tsunami.
- Desire for a national warning system (integrated with Emergency Mobile Alerts).
- Desire for integrated system, e.g. combined EEW with the provision of damage assessment information post-earthquake.
- In general people supportive of "false alarms" or "missed warnings" if they know there's a reason.
- Discussions of fatigue re: warnings for aftershocks.

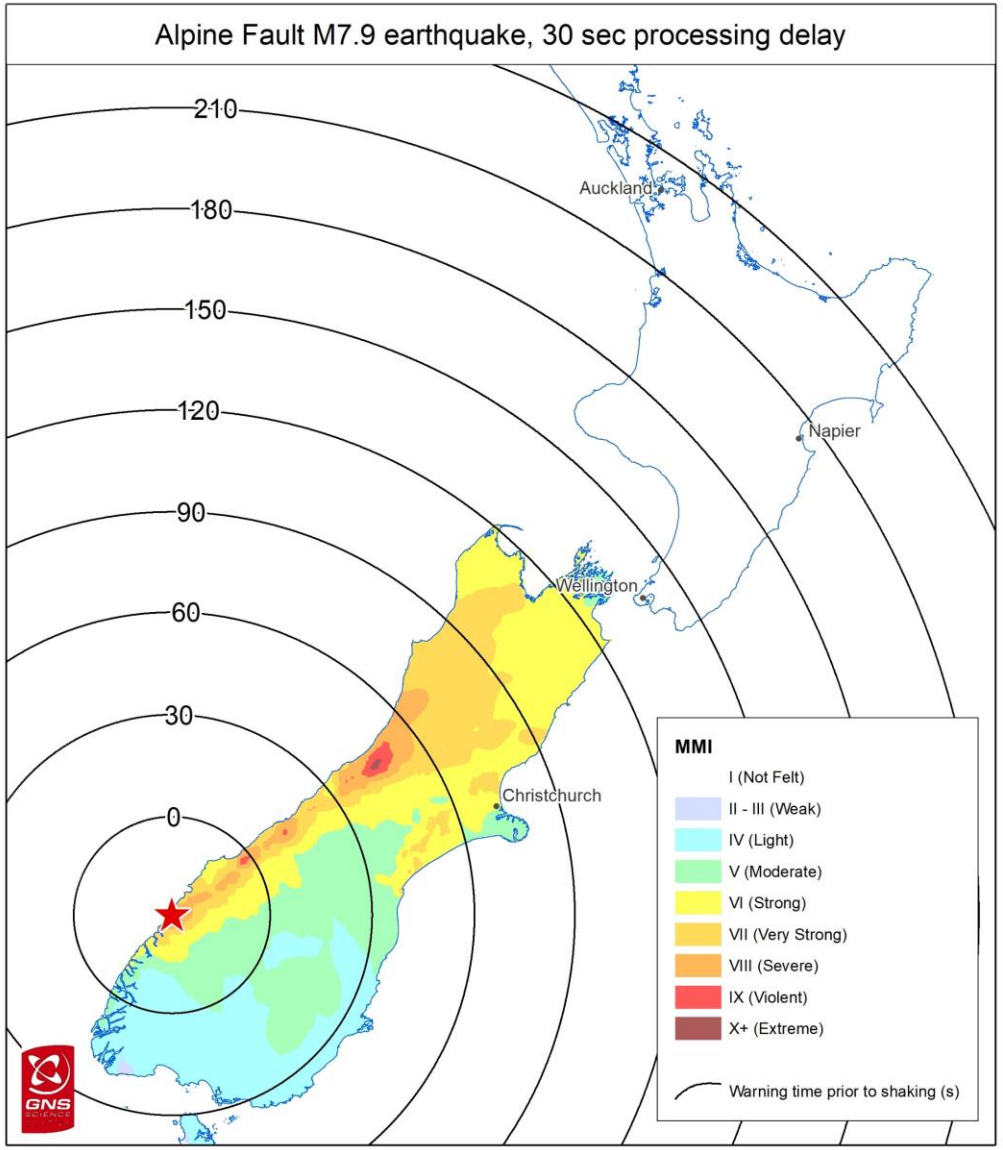
What's next?

- Finish analyzing focus group data (with any additional inputs)
- Write up the results of the Japanese data
- Finalize public survey for NZ and send out (November)
- Final reporting on whether NZ could benefit from an EEWS.

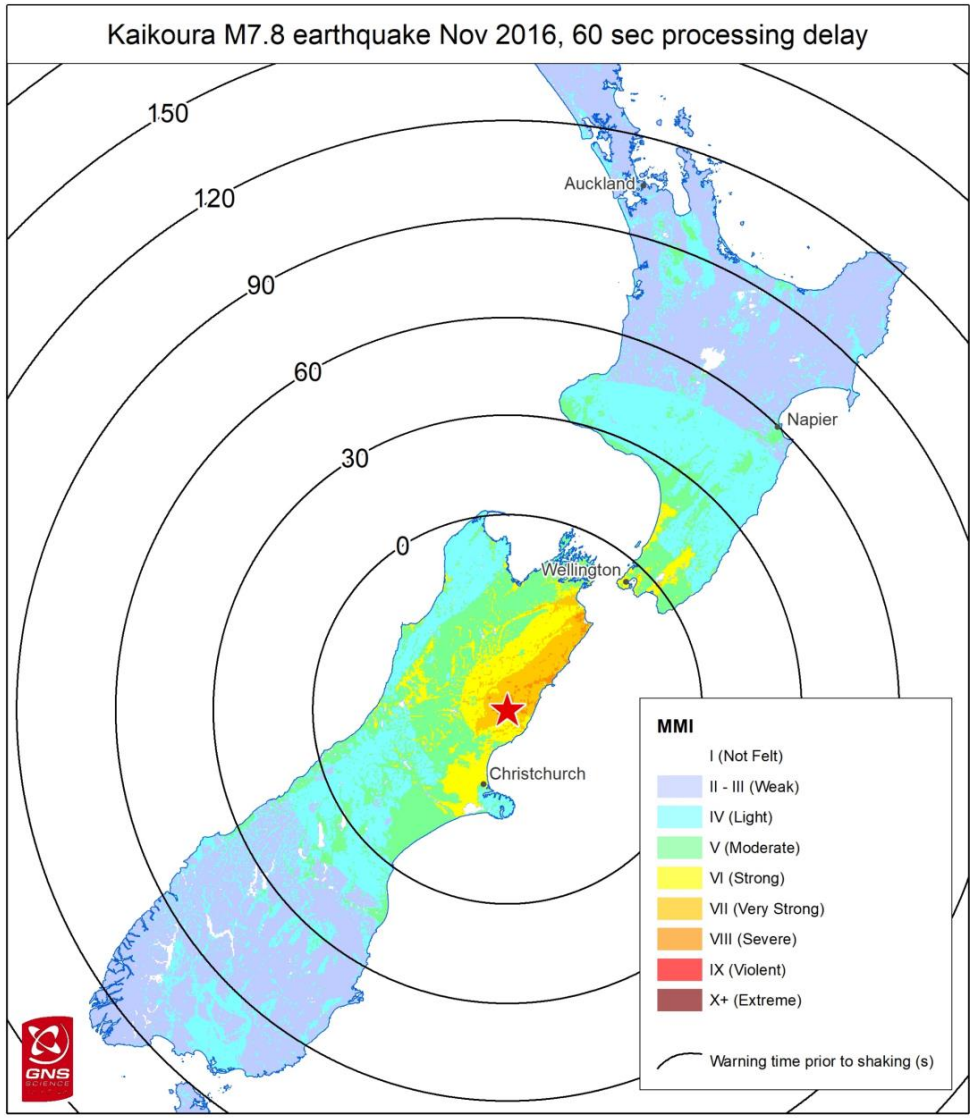


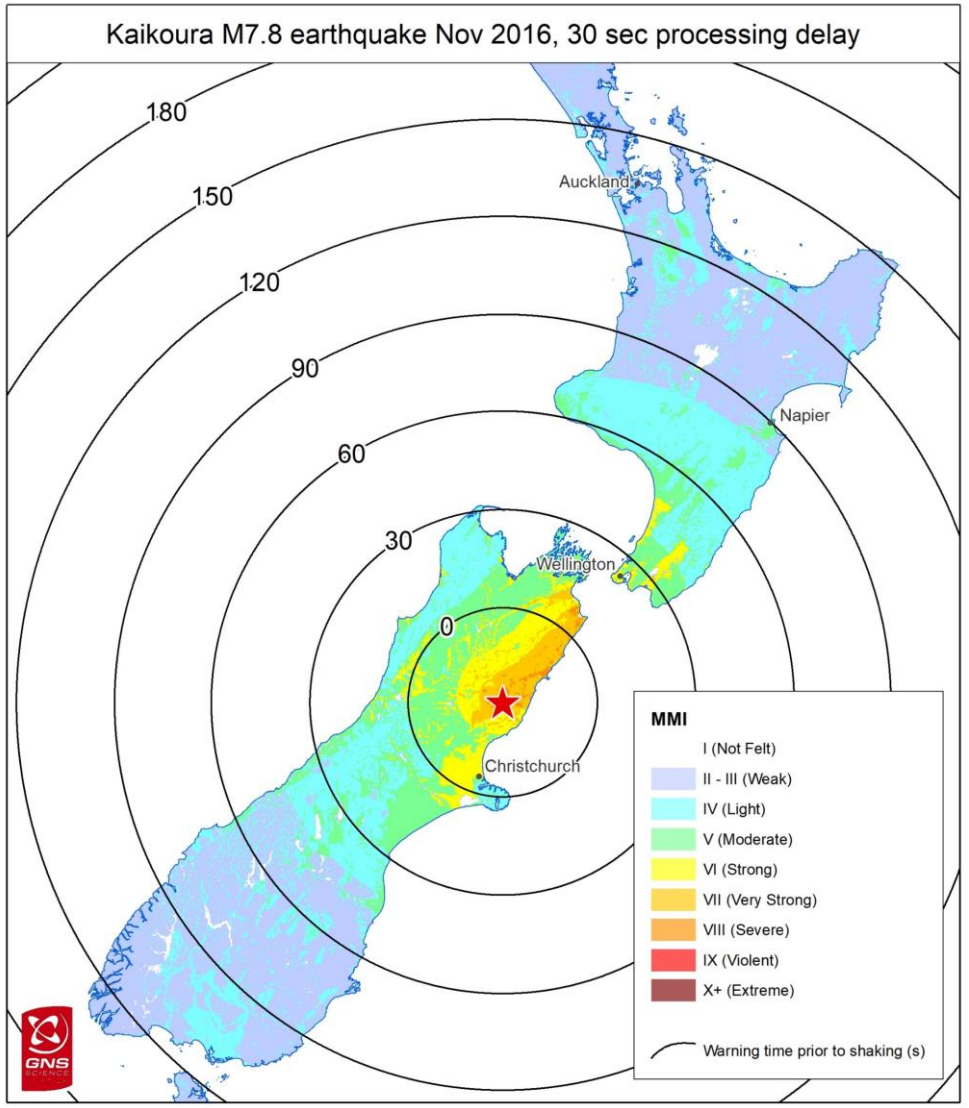
Scenario maps: Alpine Fault





Scenario maps: Kaikoura





Earthquake wave propagation models

- M8.4 Hikurangi earthquake. The location is different from South Hikurangi – near Waipukurau – but it provides an example of how the waves propagate

  https://www.youtube.com/watch?v=VxFjyk449Yk&t=19s

- M7.9 Alpine Fault (AF8 scenario) model

  https://www.youtube.com/watch?v=rUZYpBBSFzU

- M7.8 Kaikoura earthquake

  https://www.youtube.com/watch?v=1DybzjUsjN0