

Enhance Earthquake Information



Ken Gledhill (Acting Director, Hazards Division)
GeoNet Project Director; Chair, Pacific Tsunami
Warning and Mitigation System
GNS Science, New Zealand



Outline

- **The Data Explosion**
- **The Canterbury Earthquakes**
- **Aftershocks**
- **More Information Quicker**

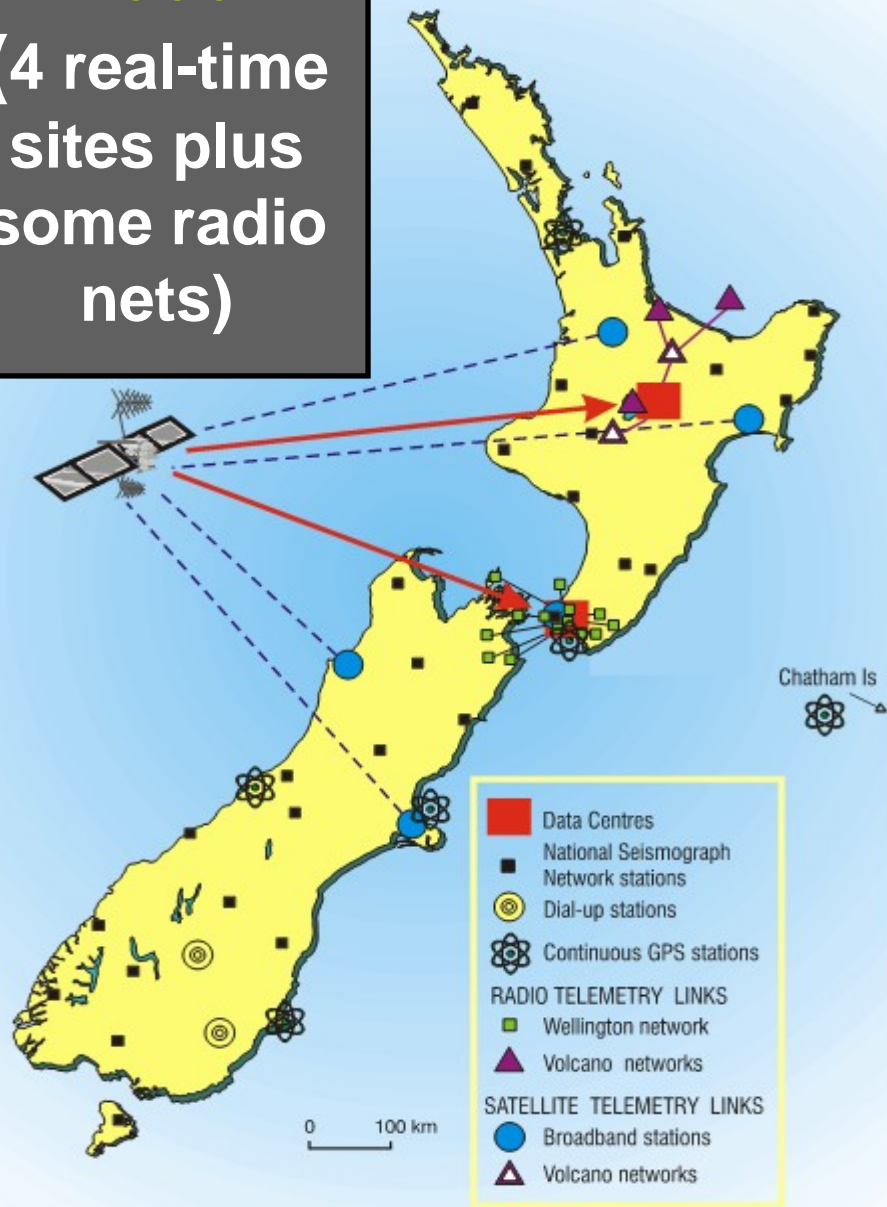
Acknowledgements: EQC, LINZ, GNS Science, Natural Hazards Platform, the GeoNet Team and a large number of research scientists

If the Canterbury Earthquakes had Occurred a Decade Ago

- 1 real-time station in Canterbury
- 2 real-time, and a small number of “dial-up” stations in the whole South Island
- The rest of the stations recorded on cassette tape which were mailed to us weekly
- It would have taken at least an hour to get an approximate location

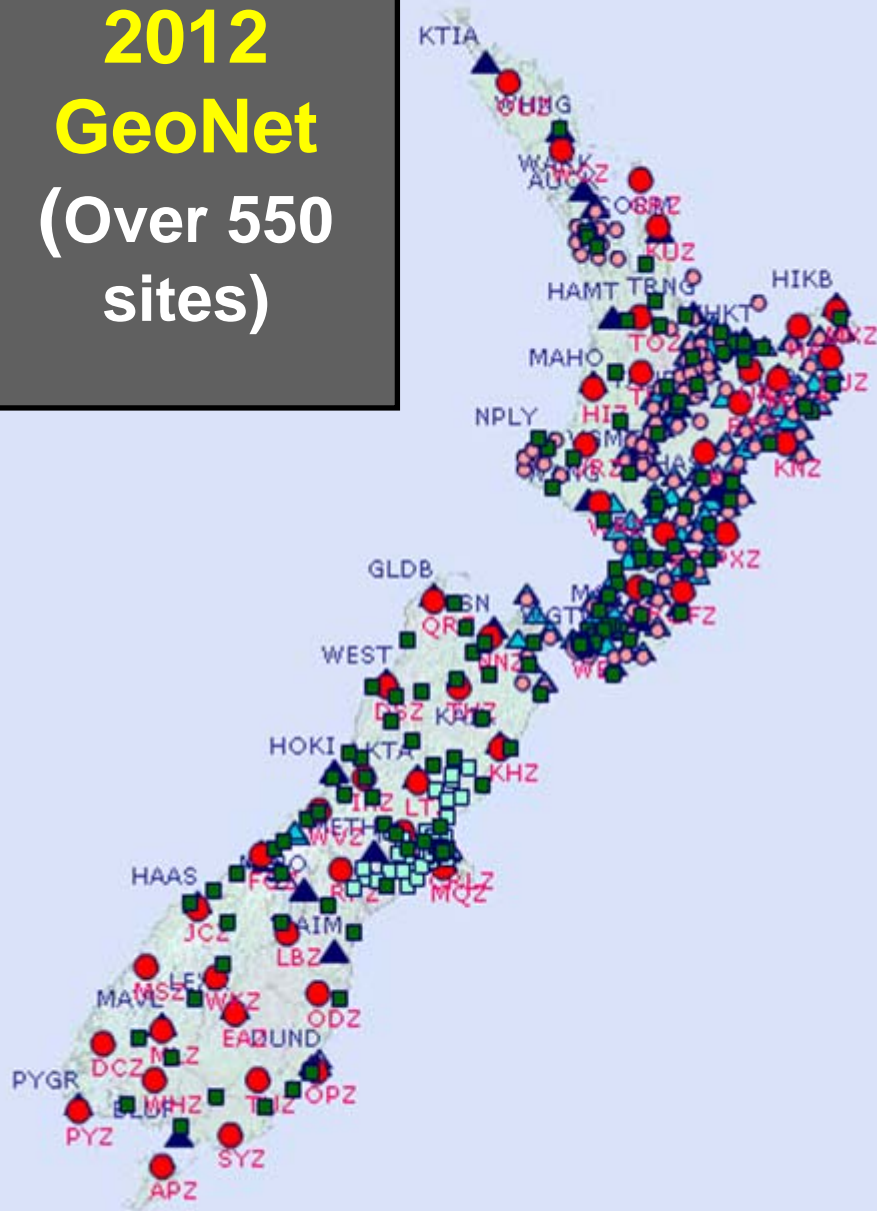
2000

(4 real-time sites plus some radio nets)

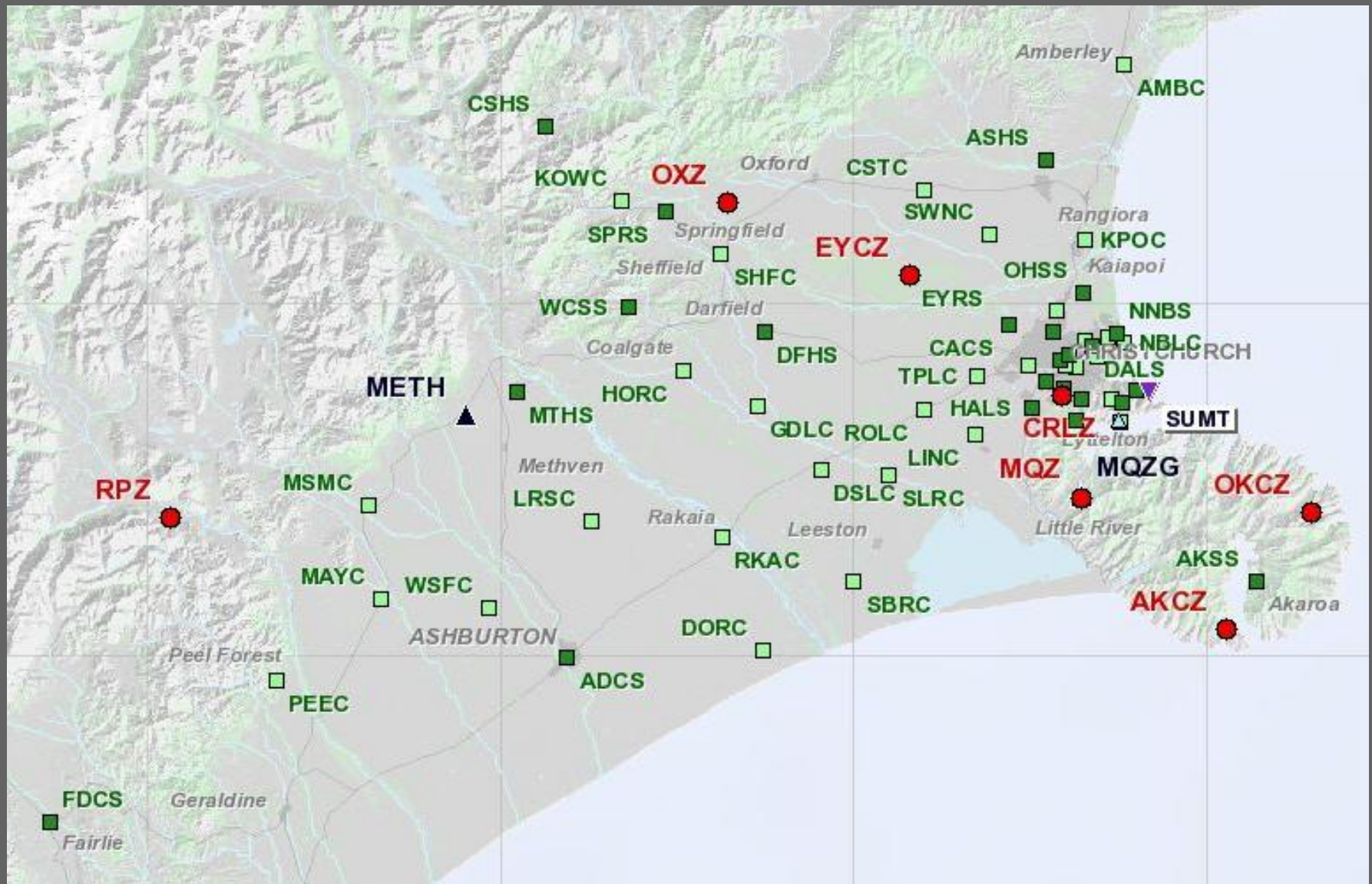


2012
GeoNet
 (Over 550 sites)

GEN.GLE.0001.4



Canterbury Sensor Network Sites



Canterbury Earthquakes

- A sequence of destructive earthquakes affecting New Zealand's second largest city, Christchurch beginning in September 2010
- To date there have been four significant periods of activity
- The earthquakes are shallow (< 10 km) and very high impact for their size
- All of the major earthquakes show a degree of complexity, particularly the Darfield earthquake of September 2010
- The closeness to the city centre was important for the level of damage, but there were several other factors
- Similar characteristics to some earthquake sequences in slow strain rate (long return time) regions

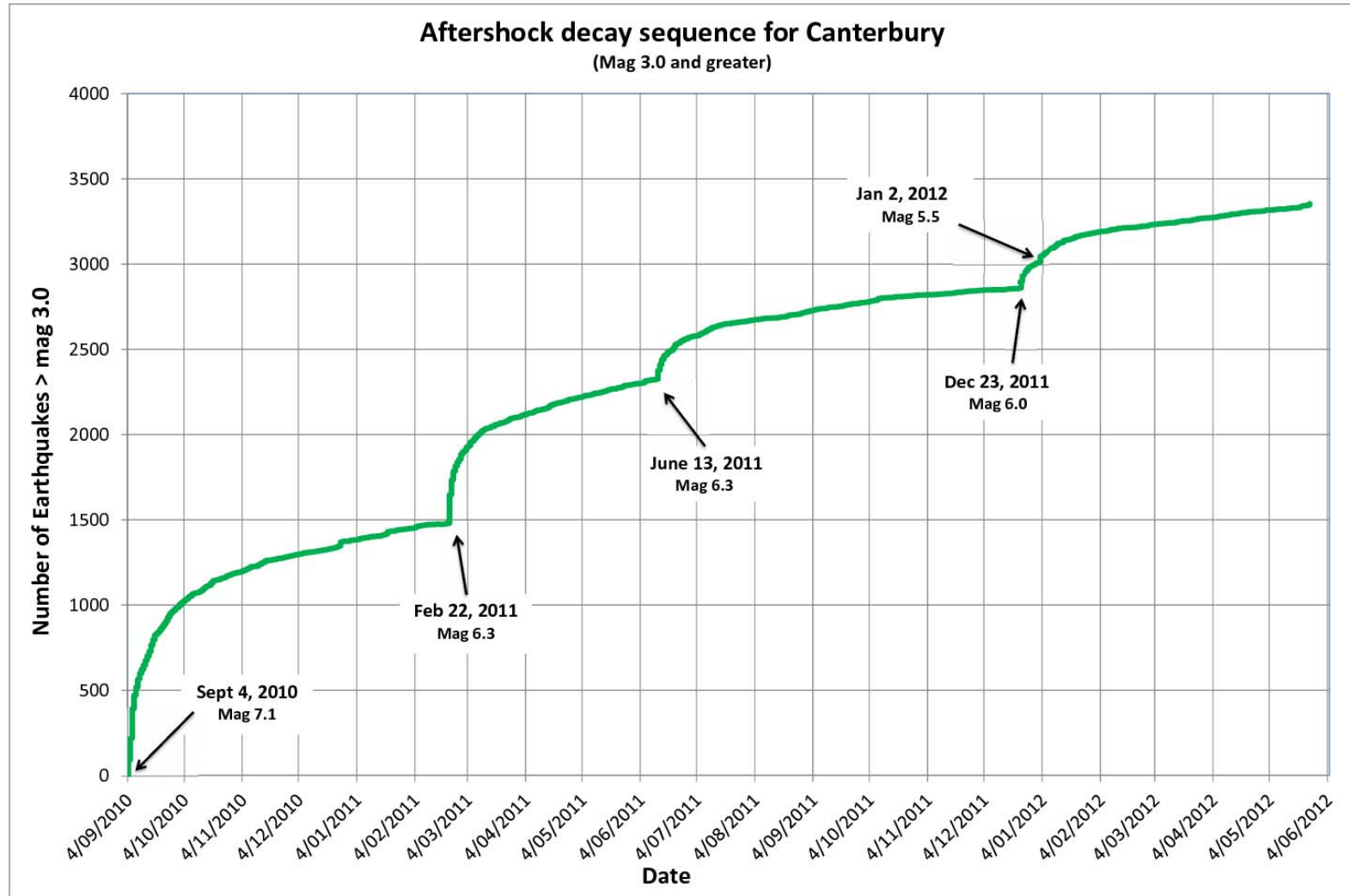
Christchurch Earthquake (22 February 2011)

- **Maximum recorded acceleration of 2.2 g (vertical)**
- **Rupture very close to the city centre (within 6 km)**
- **Earthquake had a large thrust component, and no surface rupture**
- **Energy very high for size of earthquake**
- **Rupture towards the city produced directional shaking towards the city centre**
- **Rupture speed was close to shear-wave velocity**

Possible Similar Sequences

- **New Madrid 1811-1812** (3, ~M 7.5, 53 days)
- **Oamaru 1876** (3, ~M 5.7, 46 days)
- **Tasmania 1883-1892** (3, ~M 6+, 2450 days)
- **Buller 1929** (5, ~M 6.3 – 7.3, 23 days)
- **Tennant Creek 1988** (3, M 6.3 – 6.4, same day)
- **Landers 1992-1999** (3, M 6.1 – 7.3, 2666 days)

Canterbury Aftershocks (1)



Canterbury Aftershocks (2)

**Numbers of
Canterbury region
earthquakes since
September 4 2010**

Magnitude range	Number
7.0 and above	1
6.0 - 6.9	3
5.0 - 5.9	54
4.0 - 4.9	467
3.0 - 3.9*	3422

* not all earthquakes in this range have been analysed yet.

This table was last updated on August 30 2012

New Developments

- **GeoNet Rapid – Faster earthquake locations**
- **ShakeMap**
- **Revised aftershock probabilities (using clustering)**
- **Revised hazard models after major earthquakes (time varying hazard)**
- **An emphasis on communicating hazard and risk in useable and understandable ways**

GeoNet Rapid (beta.geonet.org.nz)

GeoNet

Connect

Maps

Quakes

Volcano new!

Tsunami

www.geonet.org.nz

Welcome to GeoNet Rapid (Beta) - this page is for testing purposes only and should not be referred to in any official context.



Drums

Regions

New Zealand:

All

Felt

Latest

Statistics

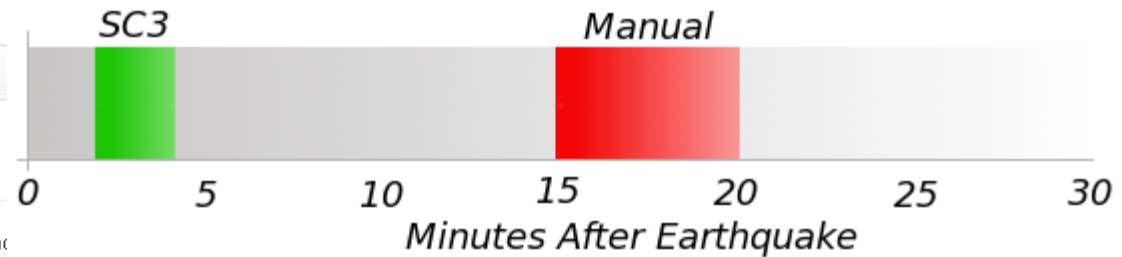
More



Home

Home

This is a list of recent earthquakes that may have been felt in the New Zealand



Public Id: [2012p656763](#)

NZST: Friday, August 31 2012 at 12:03:29 pm

Intensity: **light**

Depth: 15 km

Magnitude: 3.0

Location: 45 km west of Te Anau

Felt it?



Public Id: [2012p656266](#)

NZST: Friday, August 31 2012 at 7:38:36 am

Intensity: **severe**

Depth: 3 km

Magnitude: 5.2

Location: 30 km south-west of Haast

Felt it?



Public Id: [2012p655711](#)

NZST: Friday, August 31 2012 at 2:43:20 am

Intensity: **light**

Depth: 3 km

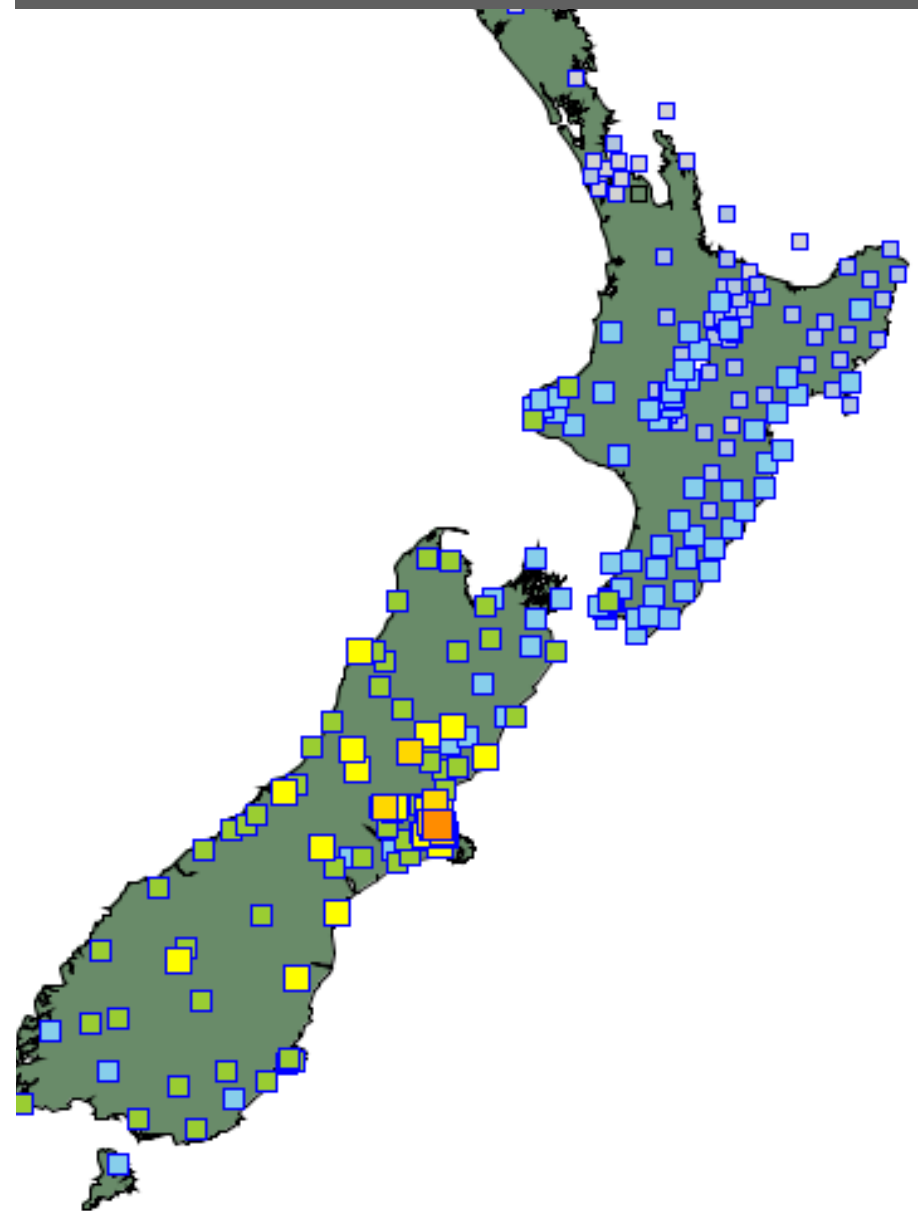
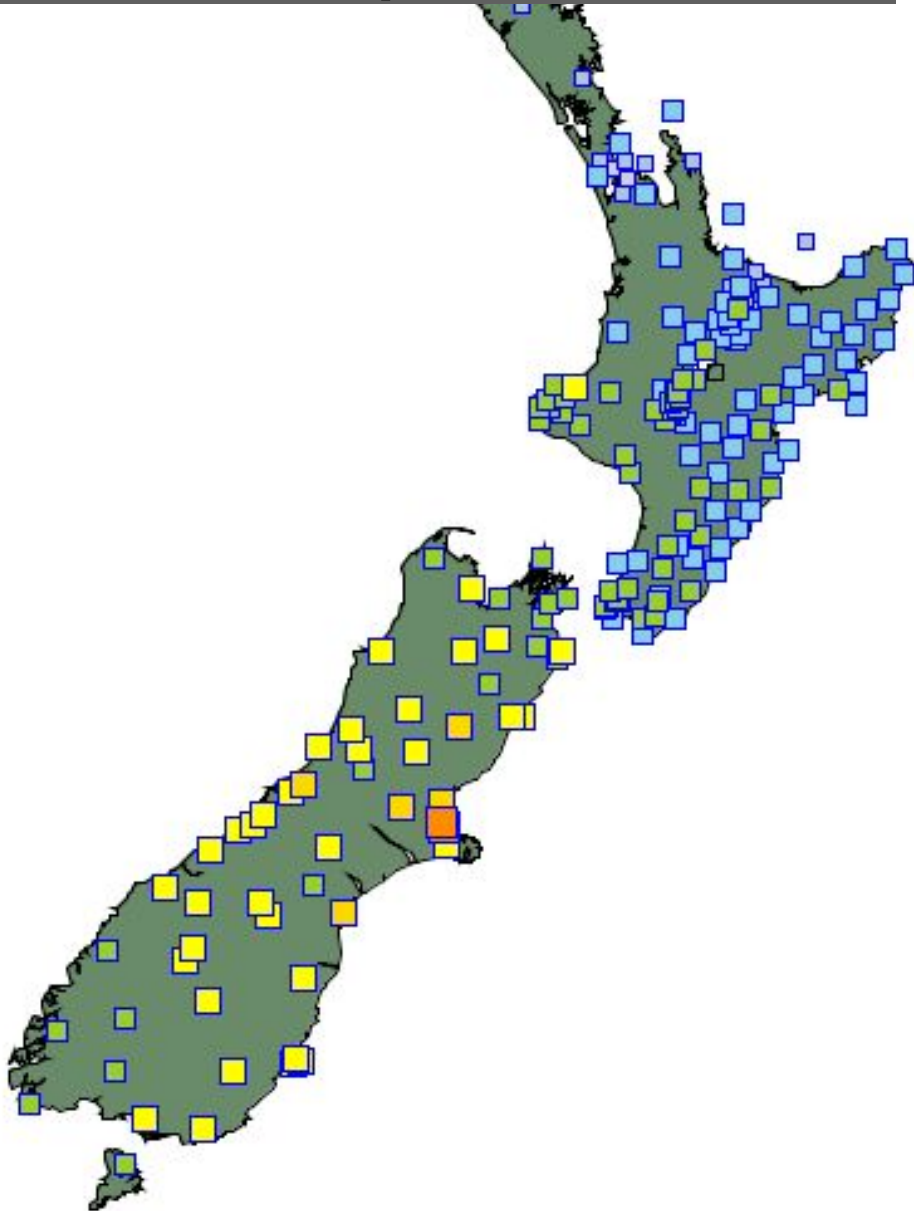
Magnitude: 3.2

Location: 15 km north of Whakatane

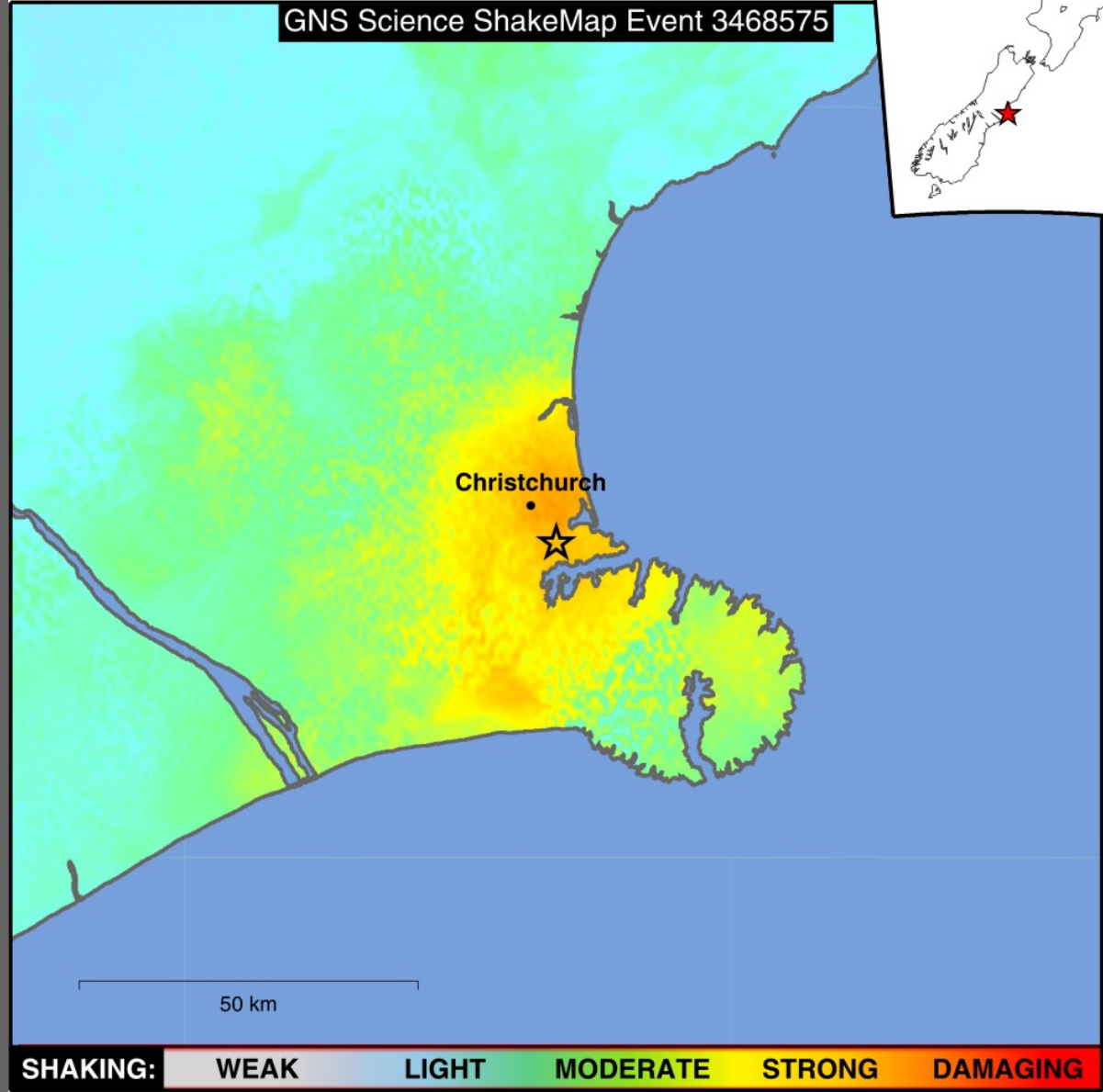
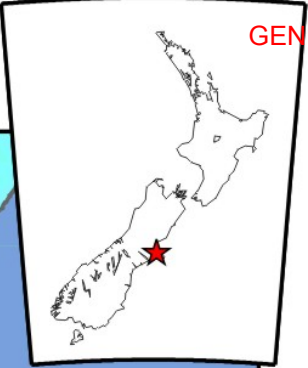
Felt it?

M 7.1, September 2010

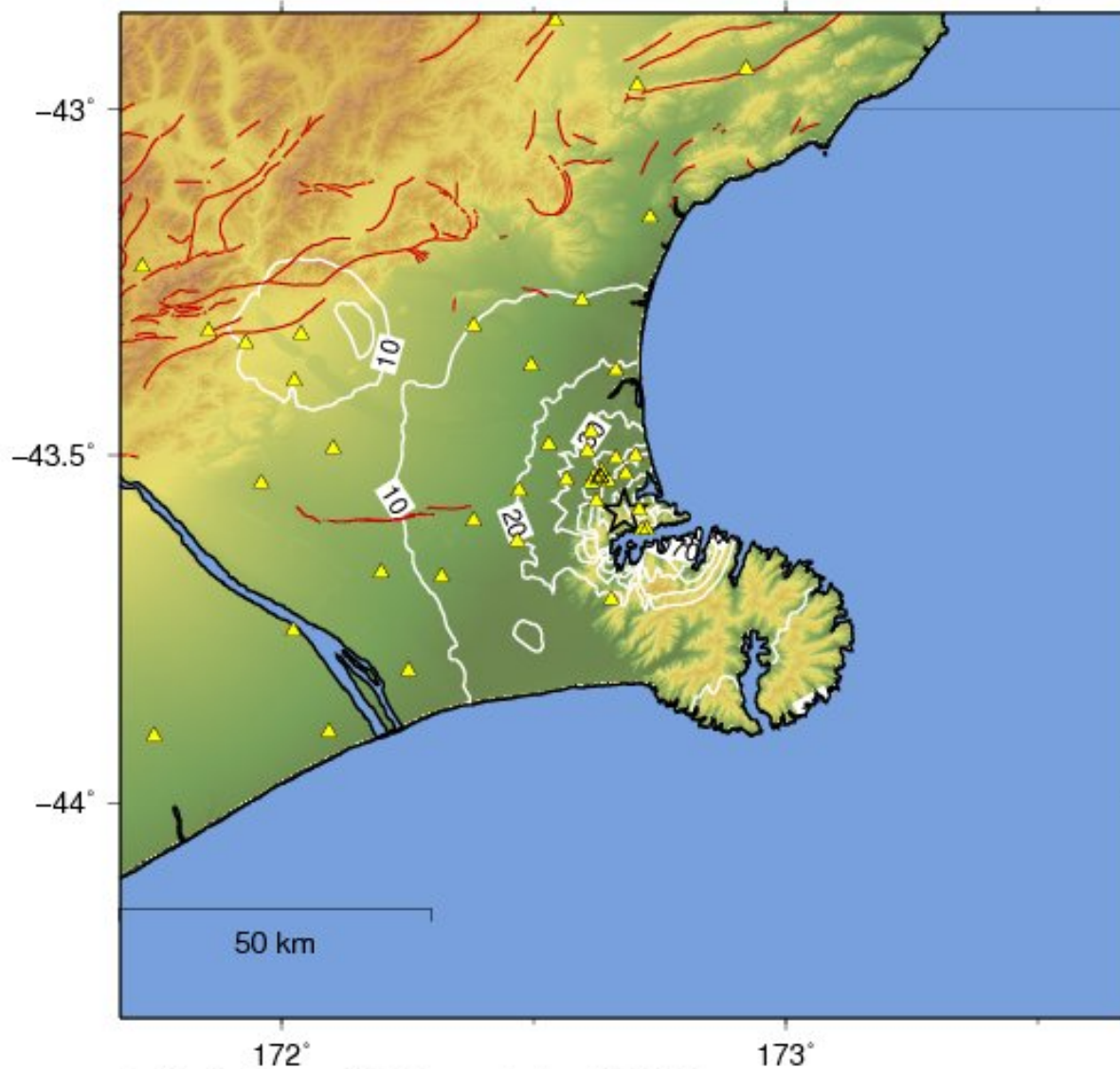
M 6.2, February 2011



GNS Science ShakeMap Event 3468575

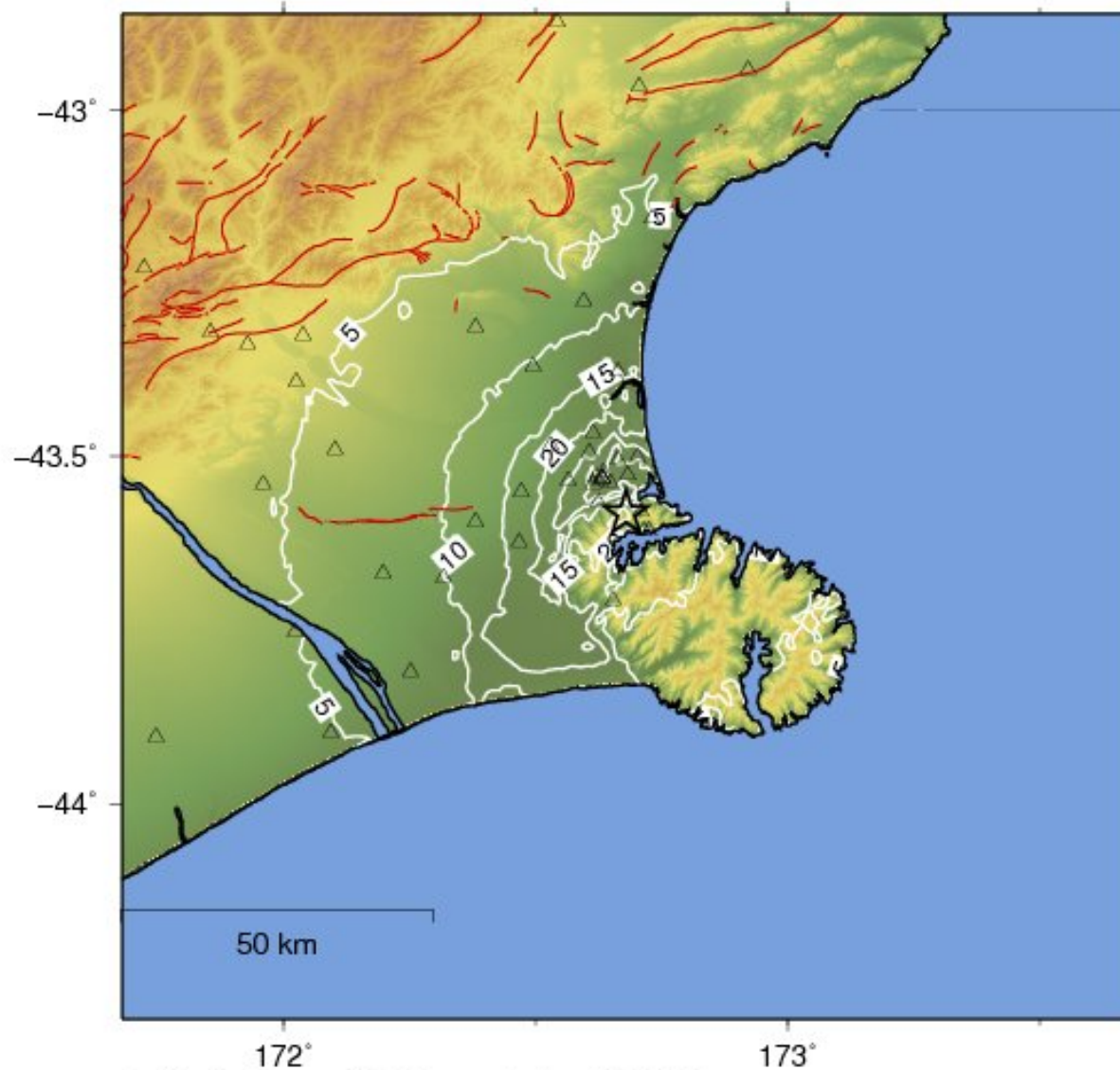


GNS Science Peak Accel. Map (in %g) : Christchurch
FEB 21 2011 11:51:42 PM GMT M 6.2 S43.58 E172.68 Depth: 6.0km ID:3468575



Map Version 1 Processed Thu Aug 30, 2012 12:02:43 PM ISLE

GNS Science 1.0 s Pseudo-Acceleration Spectra (%g) : Christchurch
FEB 21 2011 11:51:42 PM GMT M 6.2 S43.58 E172.68 Depth: 6.0km ID:3468575



Map Version 1 Processed Thu Aug 30, 2012 12:02:43 PM ISLE

Canterbury Aftershock Probabilities

Canterbury region long-term probabilities

Magnitude range	One month: August 9 - September 8 2012			One year: August 9 2012 - August 8 2013		
	Expected range	Expected average	Probability	Expected range	Expected average	Probability
5.0 - 5.4	0 - 1	0.15	14%	0 - 4	1.3	74%
5.5 - 5.9	0 - 1	0.04	4%	0 - 2	0.4	32%
6.0 - 6.4	0 - 1	0.011	1%	0 - 1	0.1	10%
6.5 - 6.9	0 - 1	0.003	<1%	0 - 1	0.03	3%
7.0 - 7.9	0 - 1	0.0011	<1%	0 - 1	0.01	1%

This table was last updated on August 9 2012

Summary

- **Research using GeoNet data from the Canterbury earthquake sequence is likely to substantially change our understanding of earthquake impacts**
- **The Canterbury earthquakes are unusual but not unique (there are a few other examples in low strain rate regions)**
- **New ways of presenting the changing level of hazard in more useable ways are being developed (GeoNet Rapid, ShakeMap, aftershock probabilities, time-varying hazard).**