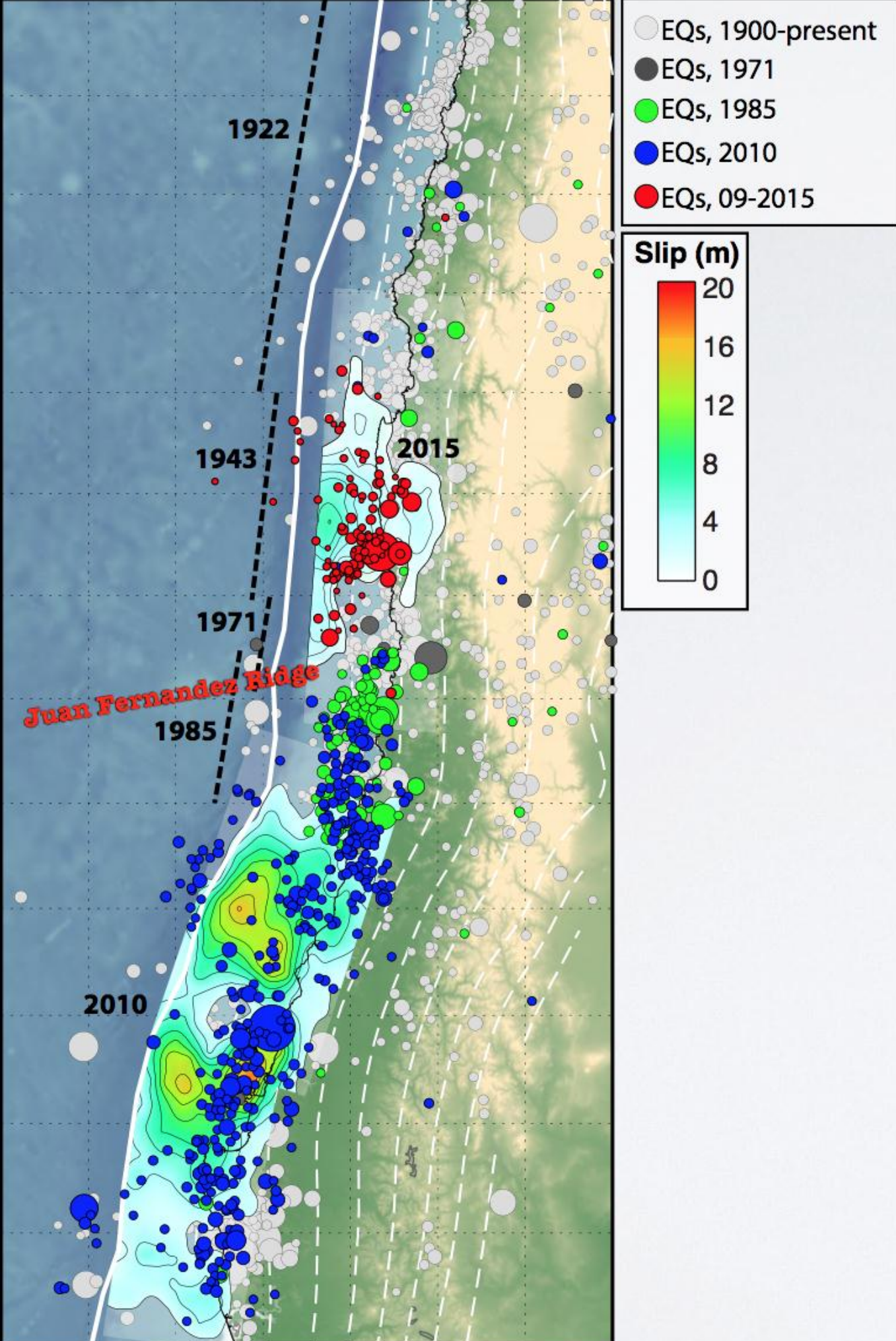


The Mw 8.3 September 16, 2015 Coquimbo, Chile Earthquake and Associated Aftershock Sequence

Compiled by Will Yeck¹, Matt Herman², Jennifer Nealy¹, Gavin Hayes¹, Bill Barnhart³, Greg Smoczyk¹, Paul Earle¹, David Wald¹, Rich Briggs¹, Harley Benz¹ and Kevin Furlong²

U.S. Geological Survey,
National Earthquake
Information Center

Results are preliminary and should not be considered as final USGS products.



A Century of Large Earthquakes in Central Chile

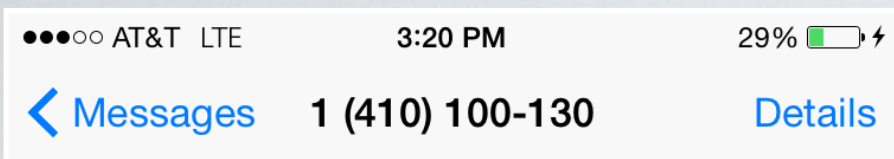
Chile has a long history of massive earthquakes, including the 2010 M 8.8 Maule earthquake in Central Chile, which ruptured a ~400 km long section of the plate boundary south of this 2015 event

Over the century prior to the September 16, 2015 earthquake, the region within 400 km of this event has hosted 15 other M 7+ earthquakes including the M 8.0 and M 7.5 1985 Valparaiso earthquakes.

This subduction zone also hosted the largest earthquake on record, the 1960 M 9.5 earthquake in southern Chile.

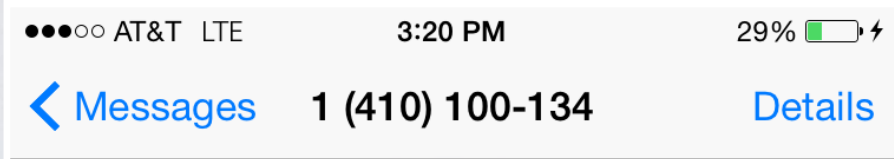
At the location of the 2015 earthquake, the two plates are converging at a rate of about 6.3 cm/yr

USGS Earthquake Products



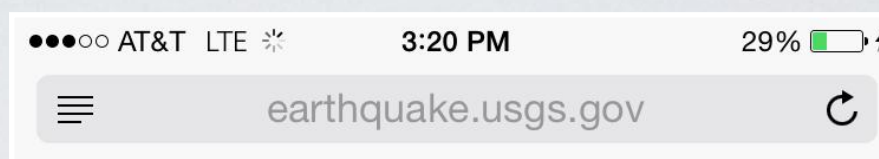
Text Message
Wednesday 5:13 PM

FRM:ens@ens.usgs.gov(USGSE NS)
MSG:PRELIM: M7.9 Z=8km
22:54 9/16 UTC, 46 km W of
Illapel, Chile <http://on.doi.gov/1UXqGR1> 243f9 reply STOP to unsub



Text Message
Wednesday 5:23 PM

FRM:ens@ens.usgs.gov(USGSE NS)
MSG:UPDATED: M8.3 Z=12km
22:54 9/16 UTC, 55 km W of
Illapel, Chile <http://on.doi.gov/1UXqGR1> 243f9 reply STOP to unsub



Menu

M8.3 - 46km W of Illapel, Chile



Location

Data Source US⁴



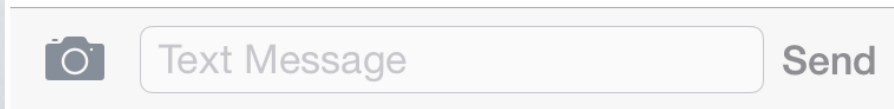
- General
- Summary
- Interactive Map
- Google Earth KML
- Impact
- Summary
- Did You Feel It?
- Tell Us!
- Shakemap
- PAGER
- Scientific

**Updated Alert
10 Minutes Later**

<https://twitter.com/USGSted>

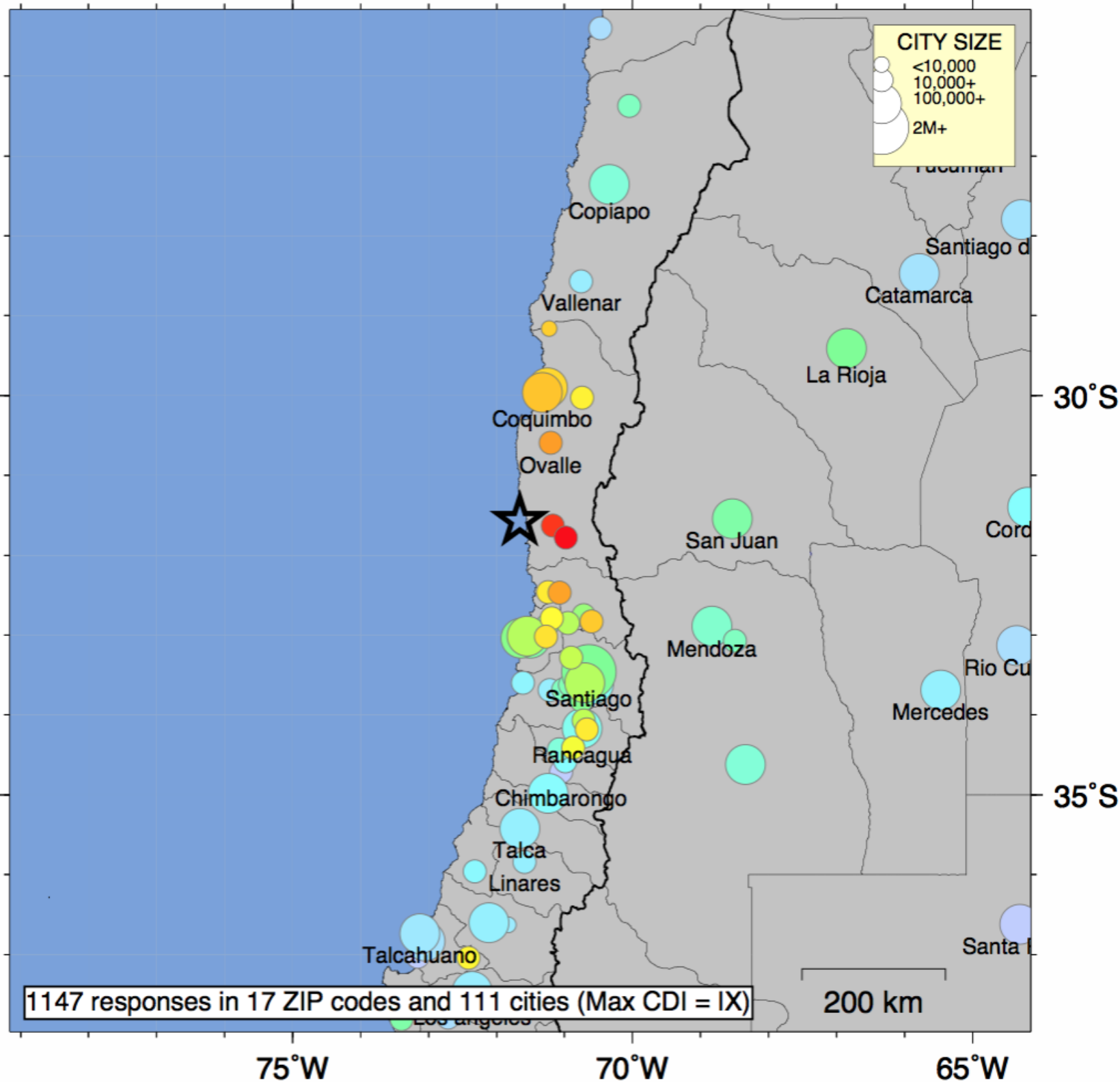
<http://earthquake.usgs.gov/earthquakes/feed/v1.0/>

<http://earthquake.usgs.gov/earthquakes/map/>



USGS Community Internet Intensity Map
OFFSHORE COQUIMBO, CHILE

Sep 16 2015 06:54:33 PM local 31.5695S 71.6543W M8.3 Depth: 25 km ID:us20003k7a



Did You Feel It? (DYFI)

- > 1000 Responses
- Largest nearby reported intensity of IX
- Moderate shaking (V) reported in Santiago Metropolitan Area

INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

Processed: Sat Sep 19 00:10:05 2015

M 8.3, OFFSHORE COQUIMBO, CHILE

Origin Time: Wed 2015-09-16 22:54:33 UTC (19:54:33 local)

Location: 31.57°S 71.65°W Depth: 25 km

FOR TSUNAMI INFORMATION, SEE: tsunami.gov

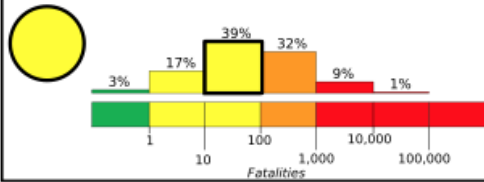
Created: 23 hours, 17 minutes after earthquake

PAGER
Version 8

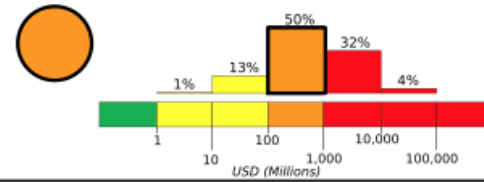
Estimated Fatalities

Orange alert level for economic losses. Significant damage is likely and the disaster is potentially widespread. Estimated economic losses are less than 1% of GDP of Chile. Past events with this alert level have required a regional or national level response.

Yellow alert level for shaking-related fatalities. Some casualties are possible.



Estimated Economic Losses

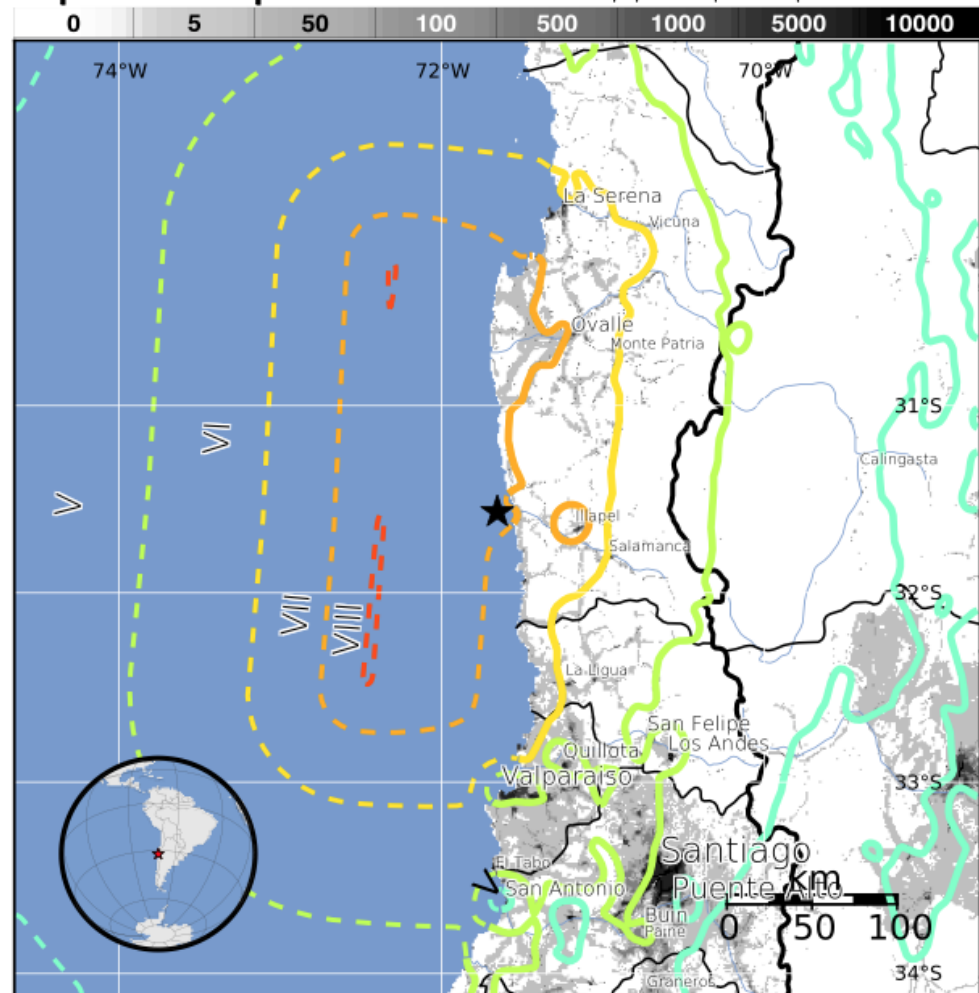


Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)	--*	--*	595k*	6,455k*	3,052k*	794k	126k	0	0	
ESTIMATED MODIFIED MERCALLI INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+	
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme	
POTENTIAL DAMAGE	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure



Structures:

Overall, the population in this region resides in structures that are resistant to earthquake shaking, though some vulnerable structures exist. The predominant vulnerable building types are low-rise reinforced/confined masonry and adobe block construction.

Historical Earthquakes (with MMI levels):

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1973-10-05	168	6.7	VIII(2k)	0
1997-10-15	90	7.1	VIII(3k)	7
1985-03-03	174	7.9	VII(7,023k)	177

Recent earthquakes in this area have caused secondary hazards such as tsunamis, landslides, and liquefaction that might have contributed to losses.

Selected City Exposure

from GeoNames.org

MMI City	Population
VIII Illapel	23k
VIII Ovalle	77k
VII Monte Patria	14k
VII Salamanca	13k
VII La Serena	155k
VII Vicuna	13k
V Santiago	4,837k
V Vina del Mar	295k
V Valparaiso	282k
V Puente Alto	510k
V Mendoza	877k

bold cities appear on map

(k = x1000)

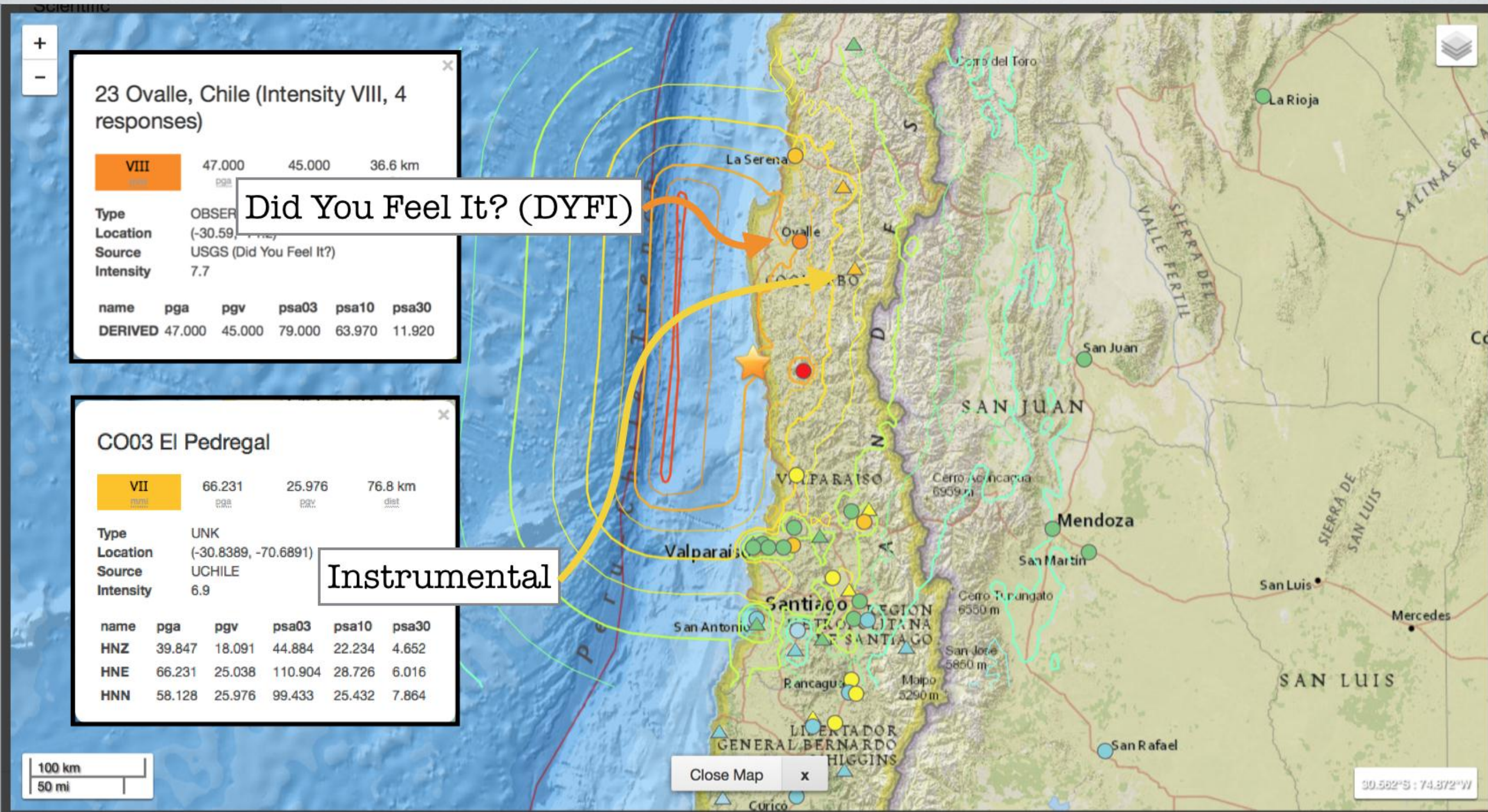
PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty. <http://earthquake.usgs.gov/pager>

Event ID: us20003k7a

Prompt Assessment of Global Earthquakes for Response (PAGER)

- Median loss estimation:
 - 60 fatalities
 - \$650M economic loss
- Chilean Red Cross reported 13 fatalities
- AIR Worldwide estimates insured losses at \$600-\$900M
- La Oficina Nacional de Emergencia del Ministerio del Interior y Seguridad Pública (ONEMI) reported more than 400 residential buildings were destroyed and 700 residential buildings sustained major damage.

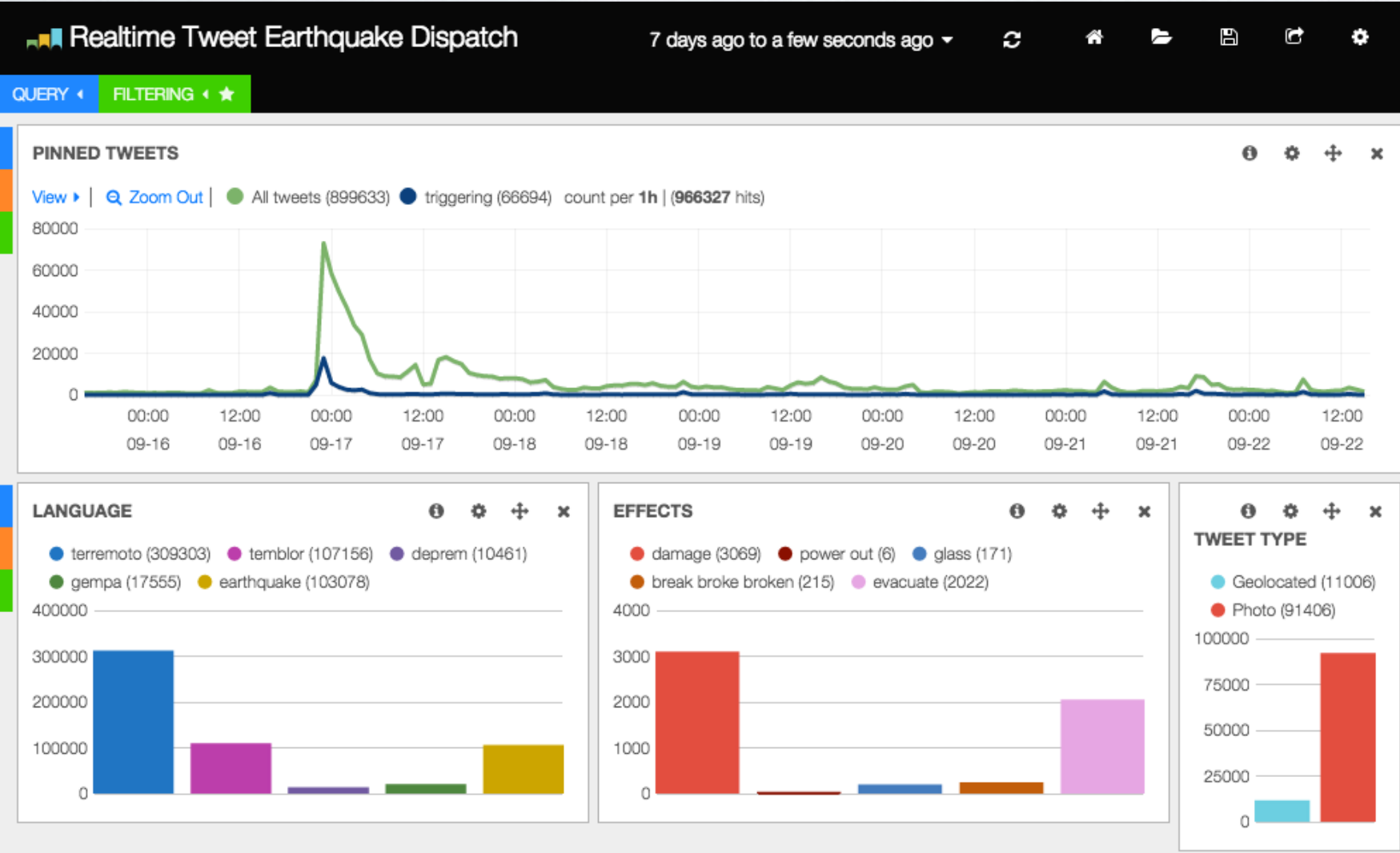
ShakeMap Intensity



INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

DYFI = circle; Instruments = triangles

Earthquake Twitter Detection (@USGSTed)

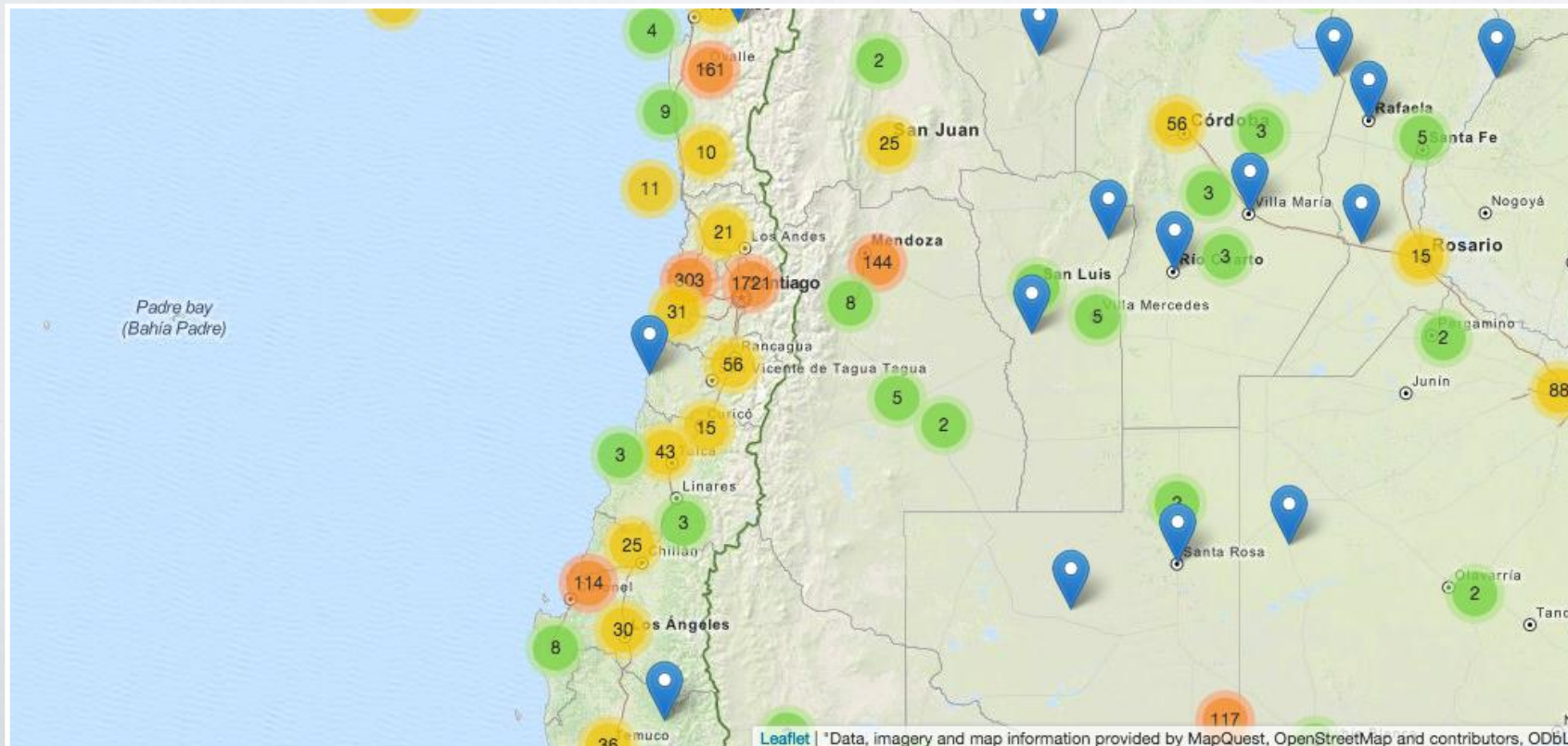


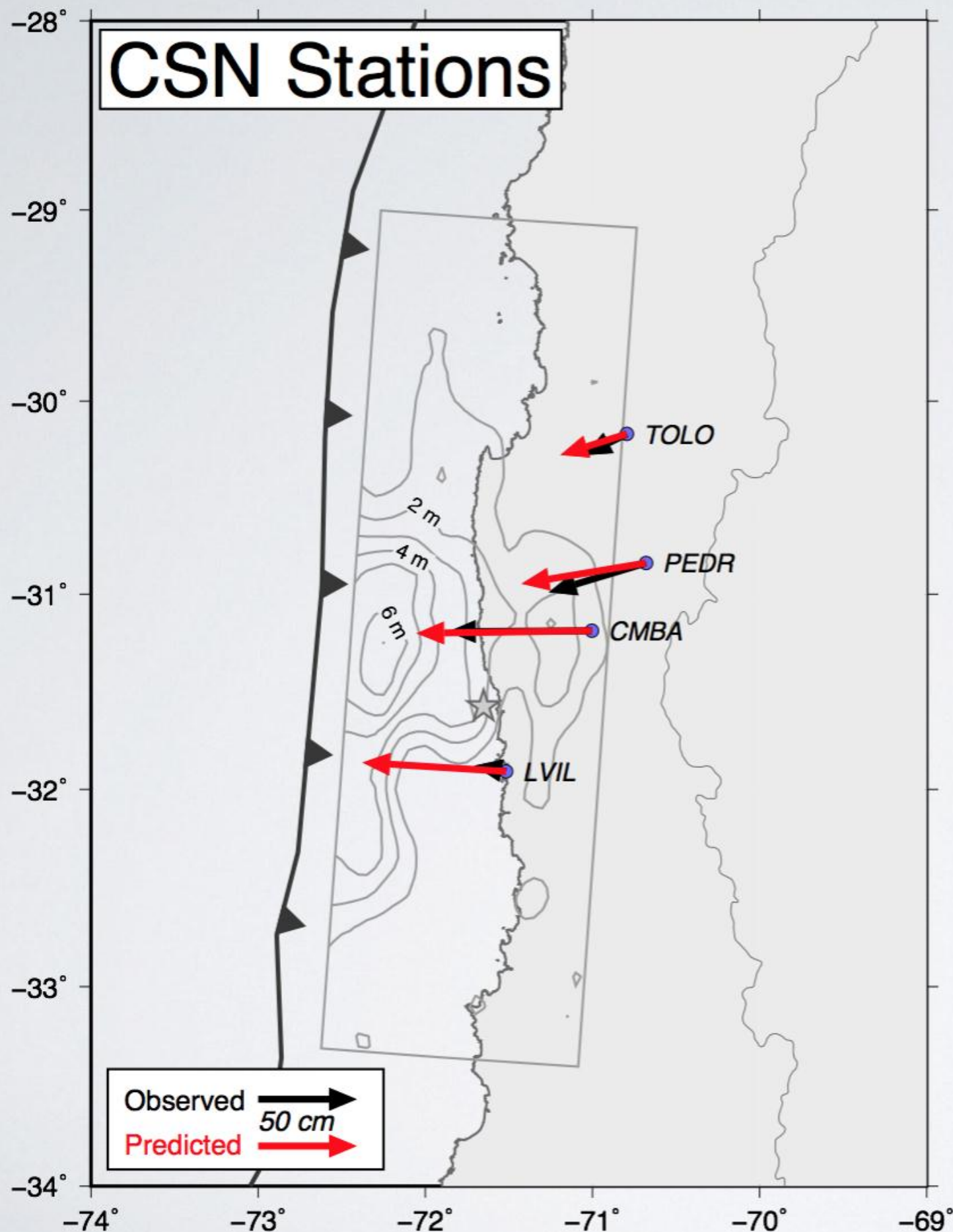
Twitter detection issued to NEIC in ~45 sec after origin time

Initial instrumental earthquake location in 99 sec

Collected 85,000 "earthquake" tweets ("terremoto" or "temblor") in the first hour

Large ratio of "terremoto" to "temblor" tweets quickly indicated a large earthquake





Predicted vs Observed Horizontal GPS Displacements

- Predicted horizontal displacement from teleseismic finite fault model
- Red arrows indicate predicted horizontal displacement from finite fault model
- Black arrows indicate horizontal displacements observed at GPS stations

Data Source: University of Chile
<http://www.csn.uchile.cl/desplazamientos-del-terremoto-de-illapel-2015/>

Seismo-summary

Mw 8.3 earthquake is on a shallow angle thrust fault within the subduction zone plate boundary between the Nazca and South America plates

Rupture initiated at a depth of about 26 km with largest rupture (> 6 m) occurring up dip (west), toward the Peru-Chile trench

Aftershocks are primarily in regions adjacent to the area of maximum earthquake slip and down dip (east) of the main fault rupture

The Mw 8.3 earthquake occurred within the rupture zone of the 1943 M8.1 earthquake and into the possible rupture zone of the 1971 M 7.8 earthquake to the south. It is adjacent to the 1922 M8.5 and 1985 M8.0 rupture zones, to the north and south, respectively

The South American subduction zone hosts a significant number of large earthquakes that provide details on strain accumulation and release during the earthquake cycle



AMERICAS

Why Chile's Latest Big Earthquake Has a Smaller Death Toll

By PASCALE BONNEFOY and PATRICK J. LYONS SEPT. 17, 2015

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📁 Save

➡️ More

[Chile](#), one of the most seismically active countries in the world, has been struck by three major earthquakes of magnitude 8 or greater in the past five years. The first, [in February 2010](#), killed 525 people, including those who died in the tsunami it spawned. But only 11 people have so far been reported killed in the latest, [which struck on Wednesday](#).

Why is the toll so much lower this time?

The latest earthquake was not as powerful.

Though the earthquake on Wednesday was quite strong, at magnitude 8.3, it released only about a third of the energy of the magnitude 8.8 quake in 2010, one of the strongest recorded in modern times. (Magnitude is measured on a logarithmic scale.)



Police officers placed tape around a damaged building in Illapel, Chile, on Thursday, a day after an earthquake hit the country. Ivan Alvarado/Reuters

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