

# Posters 2011 Humboldt County Fair



**The 2011 Humboldt County Fair Earthquake – Tsunami Room ran from Aug 11 -21 and featured posters about the February 2011 New Zealand earthquake and the March 2011 Japan earthquake and tsunami**

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## The Most Important Take Home Message



### 1) SURVIVE THE EARTHQUAKE

You can't survive the tsunami if you don't make it through the earthquake first. If you are outside, just drop down to the ground and stay put - try to avoid power lines, tree limbs and anything that could fall.



### 2) KNOW YOUR ZONE

Are you in a tsunami zone? If YES, then head to high ground or inland away from the coast as soon as you can safely walk. Do take the time to put on your shoes - walking on debris strewn streets can be hazardous. If you aren't in a hazard zone - stay where you are.



### 3) TSUNAMIS ARE TRICKY

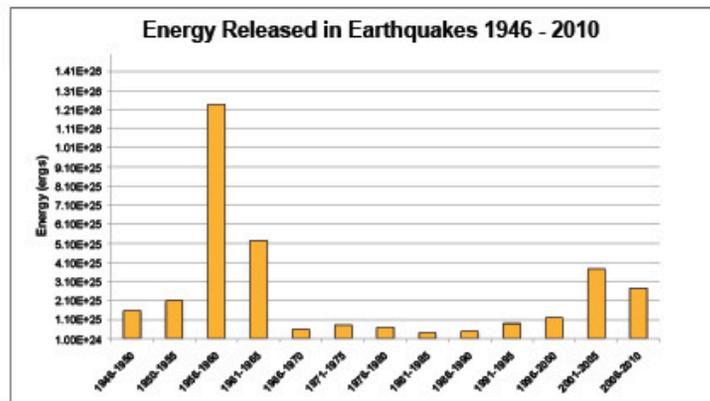
Tsunamis can come from directions you don't expect and just when you think it's all over, another big surge may arrive. The first surge won't be the biggest and it's not uncommon for waves to arrive for 12 hours and sometimes much longer. Stay away from the coast until officials say it is safe to return



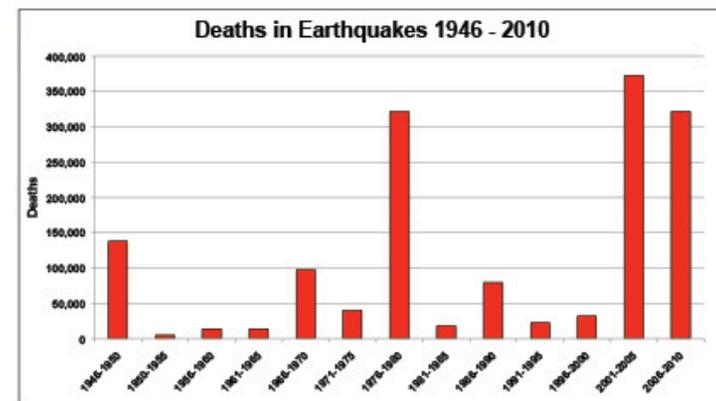
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## Are Earthquakes Increasing? Probably not

2010 had major earthquakes on the North Coast, Haiti, Chile, Baja California, China, and New Zealand. This year the earthquakes have continued with deadly earthquakes in New Zealand and the really BIG ONE in JAPAN. It sure seems like the number of earthquakes are increasing. One way to measure earthquake activity is by the energy released. The last ten years have been more active than the previous decades, but not nearly as active as 1956 - 1965.



The best way to measure earthquakes activity is by the energy released. The decade between 1956 – 1965 was much more active than recent decades.



Earthquake casualties don't correlated with the energy released! Casualties may be on the rise because of increased population and more people living in vulnerable places.

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## February 21, 2011 Christchurch, New Zealand

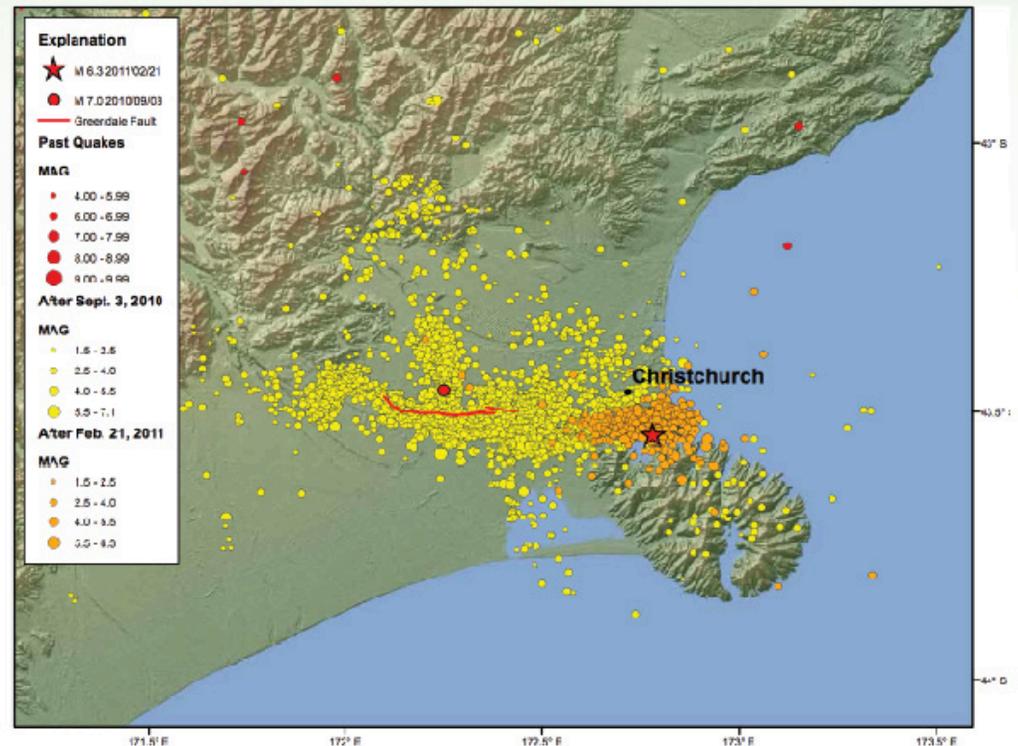
Tuesday (Feb. 22 in New Zealand) 12:51 PM PST Magnitude 6.1

~\$15 - 17 billion (US\$) in damages

181 deaths, 1500 injuries

The February 21 earthquake was an aftershock of a magnitude 7 earthquake that occurred on September 3, 2010. The larger earthquake was centered 30 miles west of Christchurch, New Zealand's second largest city (population 390,000). It was strongly felt and damaged a number of older, unreinforced buildings in Christchurch but no one died. The 2011 earthquake was only 3 miles from the Christchurch Central Business District.

The New Zealand earthquakes are an example of an aftershock causing more damage than the main earthquake in the sequence. And it might not be over yet. A magnitude 6 aftershock on June 13 caused additional damage.



The September 2, 2010 earthquake (red dot) was located on the Canterbury plane west of Christchurch. It produced a number of aftershocks (yellow circles), including several that caused damage. The February 21 aftershock (red star) was much closer to Christchurch than the mainshock and caused much more damage. The orange circles are the aftershocks that occurred after February 21 (USGS, data from GNS Science).

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## New Zealand: Liquefaction



The earthquake caused unprecedented liquefaction in the Central Business District and eastern suburbs including sand boils, settlement, uplift, and lateral spreading. More than 50% of the Christchurch area was affected. Liquefaction caused buildings and retaining walls to tilt or settle and numerous cars and trucks sunk into the mud and silt as the water gushed up. Liquefaction was the primary cause of damage to water and sewer lines, electricity and power, and roads and highways. In some areas the ground settled as much as three to six feet, making the land more susceptible to flooding and tsunami inundation.



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## New Zealand: Damage to Structures



*Christchurch Cathedral before and after. The building had suffered damage in the 1881, 1889, 1901 and 2010 earthquakes.*



*The Pyne Gould Company Building is a six-story reinforced concrete structure built in the 1960s. Twelve people died in the collapse of this building.*



*The Canterbury Television Building (CTV) is a six-story reinforced concrete structure designed in the 1970s and completed in the 1980s. The collapse of this structure accounted for 94 of the deaths in this earthquake*



*Strong shaking caused damage beyond building collapse. Bricks and other debris were thrown into the street, crushing people and objects like this bus.*

**106 of the 184 deaths in the Christchurch earthquake were the result of the collapse of two reinforced concrete office buildings. Both of these buildings were constructed before modern building codes went into effect. The greatest loss of life occurred when the Canterbury Television Building (CTV) collapsed trapping 94 people. The building housed the television station, an international language school, and a medical clinic. Hundreds of unreinforced masonry buildings were badly damaged, including Christchurch Cathedral, which lost the spire.**

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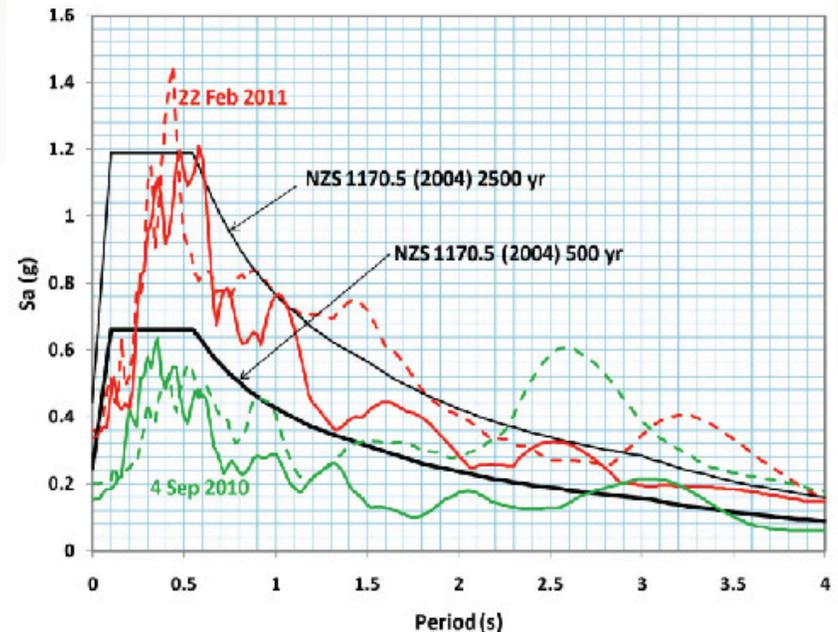
## Lessons from the New Zealand Earthquake Bigger isn't necessarily worse

The magnitude 6.1 aftershock was a much greater disaster than the Sept 3 M 7.0 mainshock, even though it was nearly 11 times smaller in terms of energy.

- **Location:** The 6.1 was only 3 miles from Christchurch, compared to 30 miles for the larger event. The very strong ground shaking in the Sept 3 earthquake was focused in an unpopulated area, sparing Christchurch. On February 21, Christchurch bore the brunt of the strongest shaking.

- **Geology:** Loose soil and fill in the Christchurch area amplified ground shaking. Sands and silts beneath the city were saturated from recent rains and many areas failed due to liquefaction. The earthquake produced the highest accelerations ever recorded in a New Zealand earthquake.

- **Time of Day:** The 7.0 occurred on a Saturday morning at 4:35 AM when almost everyone was at home. The 6.1 earthquake occurred in the middle of the work week – during the lunch hour when many people were at work or in restaurants in buildings that were severely damaged.



Comparing the ground motions in the September 3 magnitude 7 earthquake (red) and the February 21 magnitude 6.1 earthquake at site in Christchurch. The black lines show the design code limits for the 500 year and 2500 year events (EERI, data from GNS Science).

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## Lessons from the New Zealand Earthquake

- An earthquake, like the one in New Zealand, could affect any community in California. If the location and faulting characteristics, even a moderate earthquake can cause major damage.

- A good way to get injured in the earthquake was to move while the ground was shaking. Staying in one spot, or dropping down beneath a table or desk, provided the best protection.

- Our next earthquake could occur on a previously unmapped fault - just like the New Zealand earthquake. Some faults are unmapped because they stop before reaching the surface. Others are covered by thick sediments. Just because there is no mapped fault nearby, doesn't mean there is no fault rupture hazard

- The earthquake isn't over when it's over. The ongoing aftershock sequence is unnerving and hazardous. The uncertainty of what is going to happen next has many people on edge. There's a name for it - "Earthquake Fatigue." Over 10,000 Christchurch students haven't returned to school after the February earthquake.



*Each aftershock continues to chip away at the support beneath this house at Shag Rock. The continuing aftershocks have a similar effect on people's nerves.*

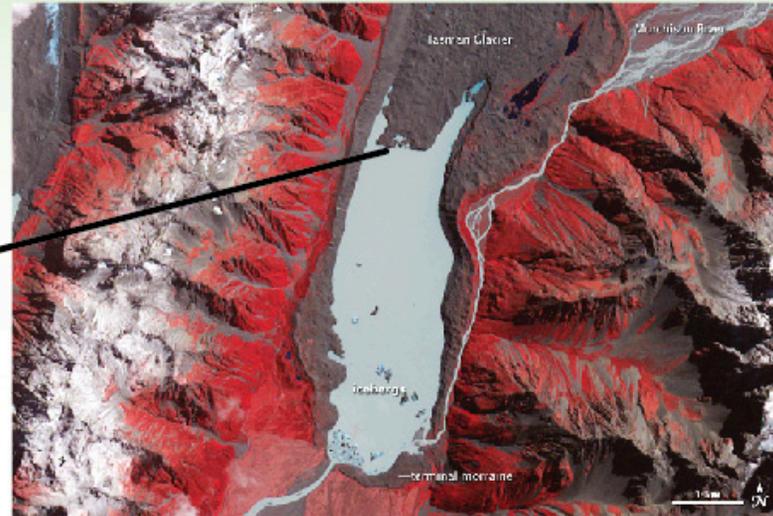
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## Lessons from the New Zealand Earthquake

A tsunami can happen in a lake



*The region of the Tasman glacier where the ice chunk broke off.*



*Tasman glacier, located 125 miles south of the epicenter, is New Zealand's largest glacier.*



*Tourists examine one of the largest chunks of the glacier piece that broke off.*

The earthquake caused a 30-ton chunk of the Tasman glacier to calve into Terminal Lake, the lake below New Zealand's largest glacier. When the  $\frac{3}{4}$  mile-long chunk fell, it caused a seiche – a sloshing of water back and forth – that lasted for at least 30 minutes. A group of tourists on a boat in the lake at the time were walloped by giant 12-foot waves created by the calving. The ice broke up in the water, forming several icebergs, one 750 feet long. We don't need to worry about glaciers calving into California lakes, but a landslide into a lake could have the same effect.

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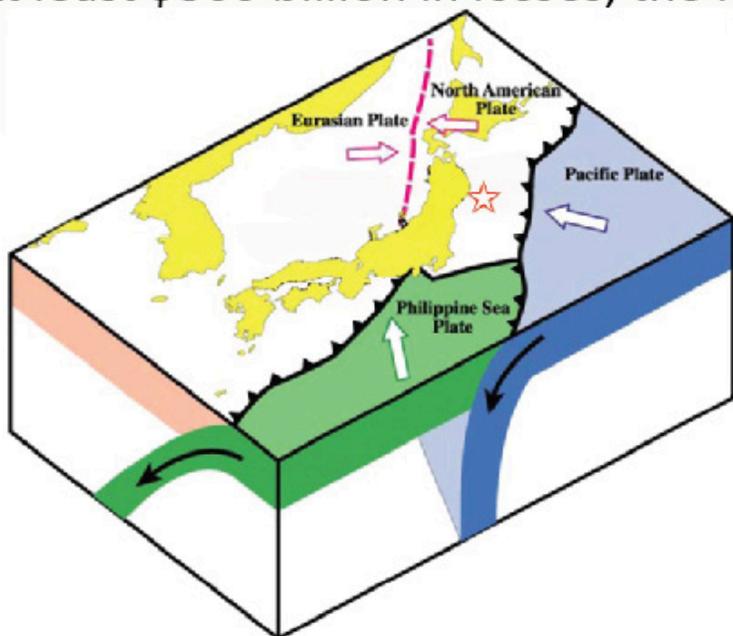
## March 11 Japan (Tohoku-oki) Earthquake

Friday 2:46 PM Local time Magnitude 9.0

16,447 people killed, 4,787 missing, 5,888 injured (Japan Fire Dept.)

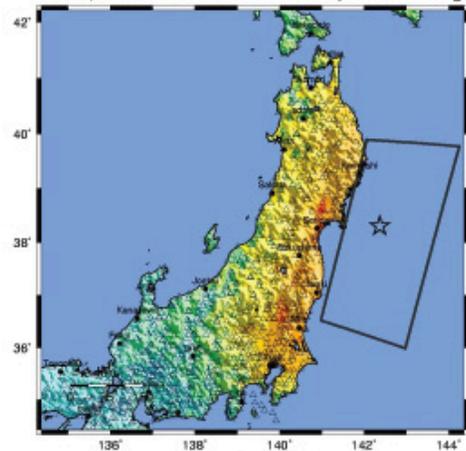
111,944 destroyed buildings, 656,920 damaged buildings

At least \$300 billion in losses, the most expensive natural disaster of all time



The earthquake was centered on the convergent plate boundary (subduction zone) between the Pacific and North American plates.

USGS ShakeMap : NEAR THE EAST COAST OF HONSHU, JAPAN  
Fri Mar 11, 2011 05:46:24 GMT M 9.0 N35.30 E142.37 Depth: 29.0km ID:c0001ggp



Map Version 13 Processed Thu Jun 23, 2011 12:26:04 PM MDT - NOT REVIEWED BY HUMAN

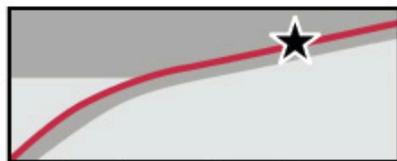
POTENTIAL DAMAGE	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC (g)	<.17	.17-1.4	1.4-3.9	3.9-6.2	6.2-19	19-34	34-65	65-124	>124
PEAK VEL (cm/s)	<5.1	5.1-11.1	11.1-5.4	5.4-8.1	8.1-19	19-37	37-60	60-118	>118
SEISMIC HAZARD ZONING	I	II-II	IV	V	VI	VII	VIII	IX	X

Over 15 million people experienced very strong ground shaking (intensity VII or greater).

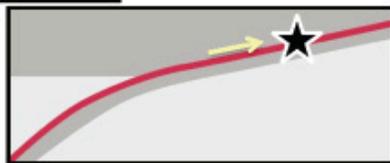
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## Japan: The Earthquake Source

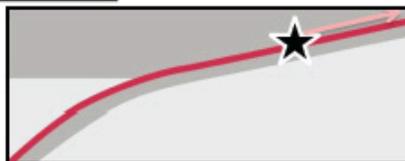
A magnitude 9 earthquake is always an extraordinary event, but the March 11 earthquake was unusual. It was “two earthquakes in one”. The figure to the right shows the epicenter (star) and the rupture area. The yellow area is the part of the earthquake that broke first. It ruptured quickly producing short period vibrations (which people perceived as very strong shaking), and the slip along the fault was moderate. After about 75 seconds, the slip jumped to the shallow part of the fault (the pink area). The rupture was much slower and didn't produce very strong shaking, but the slip was huge - as much as 150 feet - and caused the larger than expected tsunami.



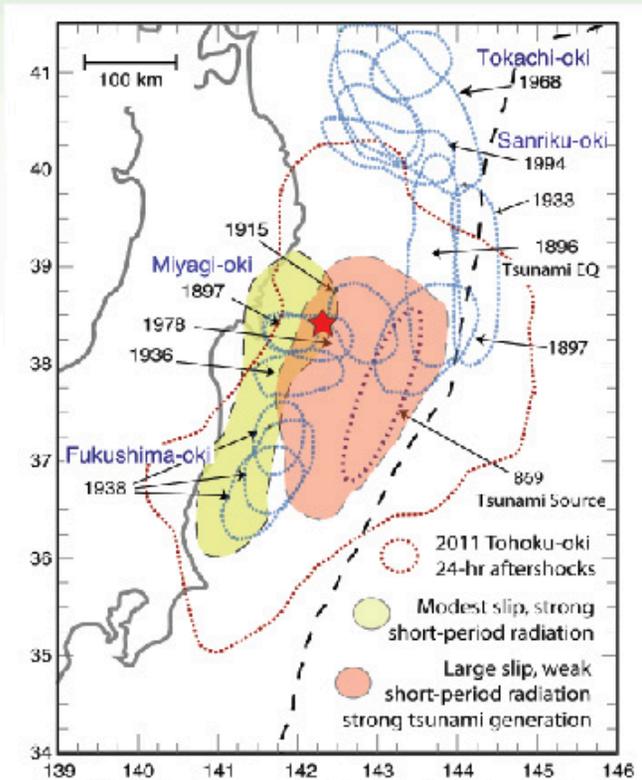
Rupture began at the star.



The yellow area broke first.



The pink area broke second - and the slip was much larger, causing a very big tsunami.



Simplified sketch of the source region. The star is the epicenter. The yellow area broke first, followed by the pink area. The red dashed area is the region of aftershock concentration and the blue dashed areas are past large earthquakes. (figure from H. Kanamori)

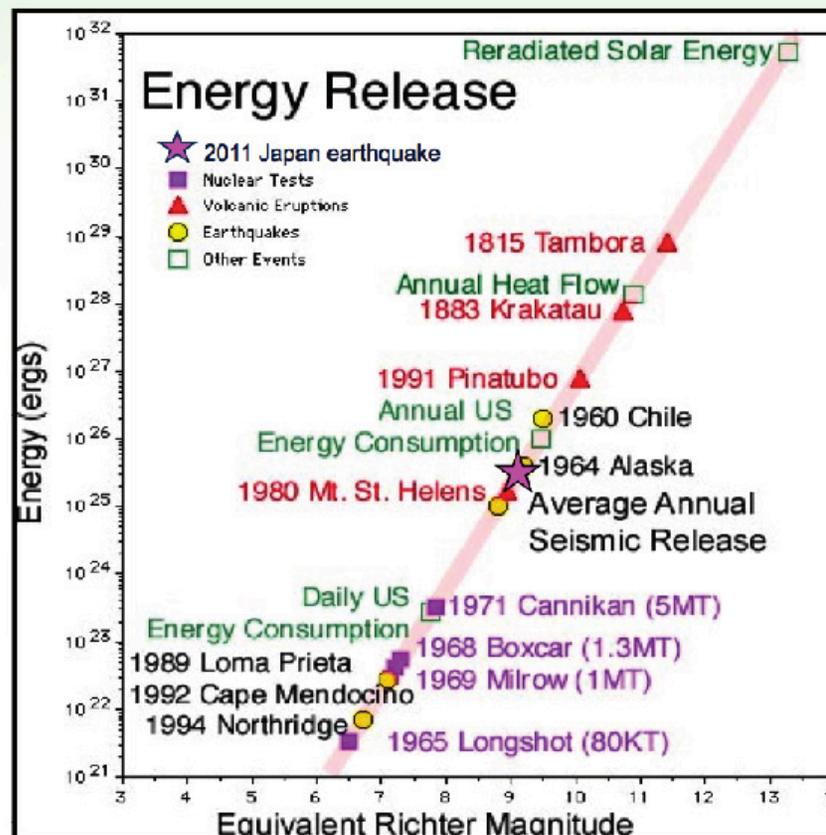
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## The Japan Earthquake: How Big Was It?

The 2011 Japan earthquake released an amount of energy equal to:

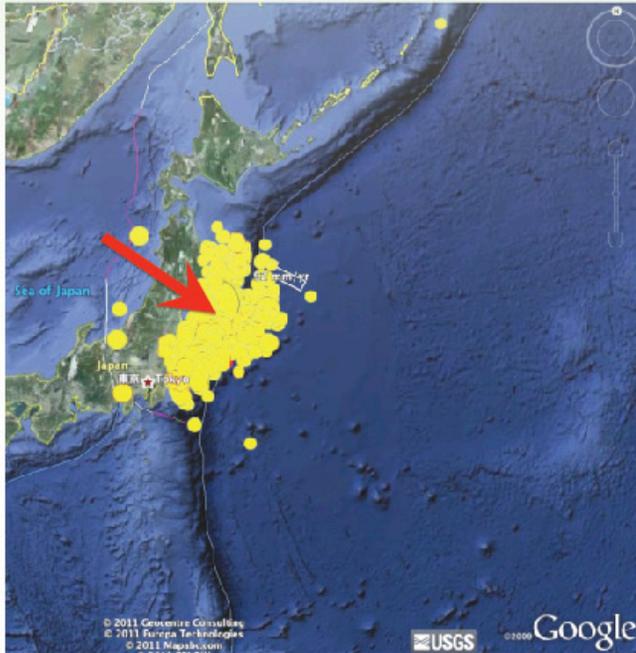
- 70,000 Hiroshima bombs
- 2 Mt. St. Helens eruptions
- 100 5 megaton hydrogen bombs
- 5,000 January 9, 2010 Eureka Earthquakes

It is tied for the fourth largest earthquake ever recorded - only the 1960 Chile, 1964 Alaska, and 2005 Indonesia earthquakes were larger.



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## Why the Japan Earthquake is Important to Northern Californians



*Mainshock (arrow) and aftershocks the first week afterwards*



*The Japan earthquake sequence superimposed on the Cascadia subduction zone*

The Japan earthquake is the same size and type that we expect to occur on the Cascadia subduction zone, the major fault system that lies along the coast of Northern California, Oregon, Washington and southern British Columbia. Japan is a modern country with building codes and infrastructure similar to ours.

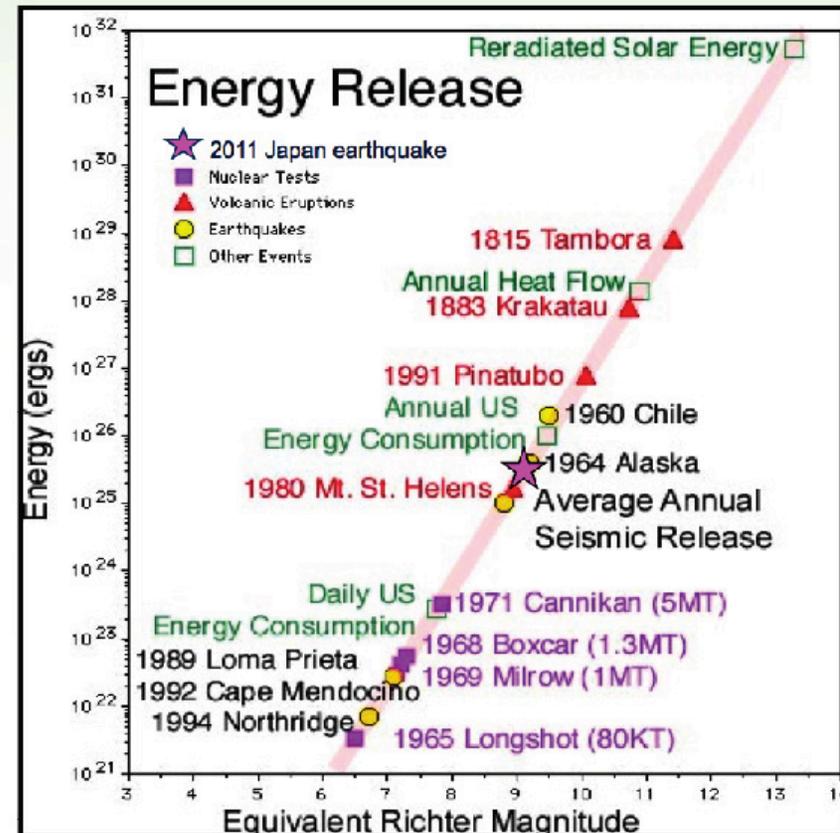
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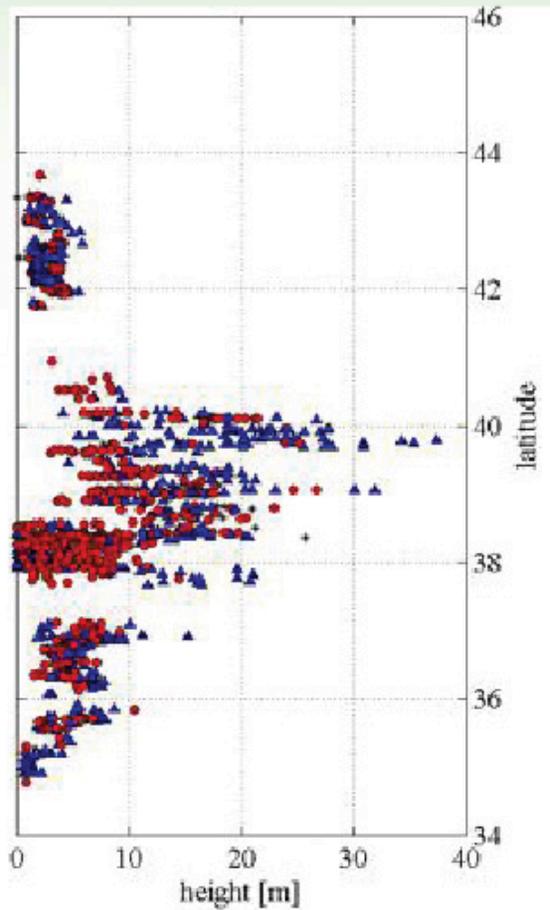
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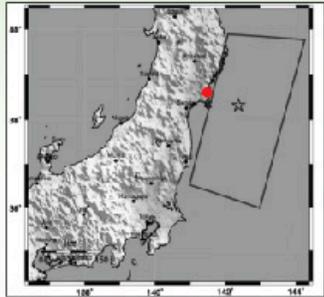
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## The Tsunami in Japan

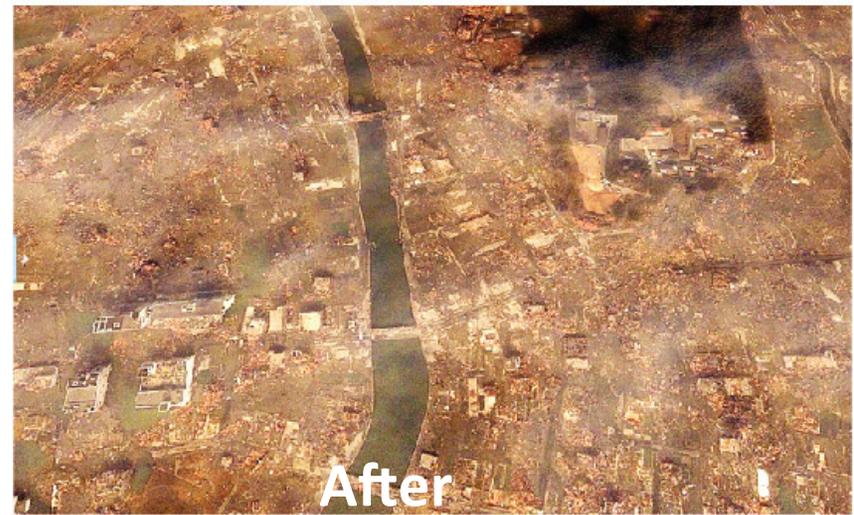


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## The Japan Earthquake from Space

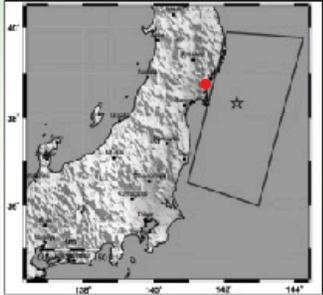


Minami Sanriku Town  
Miyagi



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## The Japan Earthquake from Space



**Kesennuma City  
Miyagi**



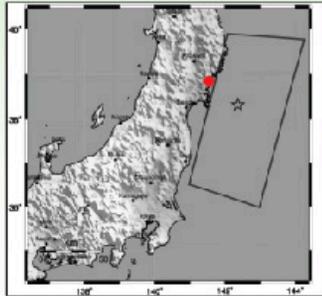
**Before**



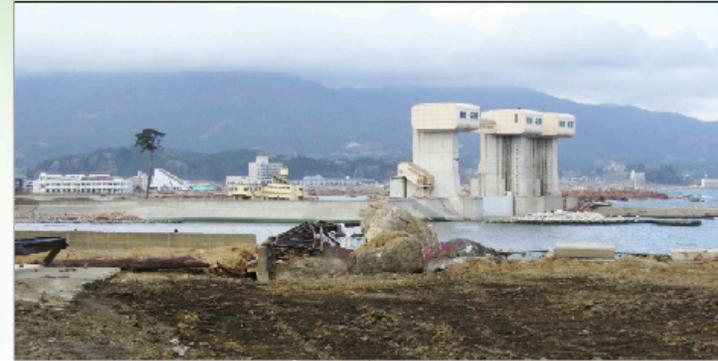
**After**

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## The Japan Earthquake from Space

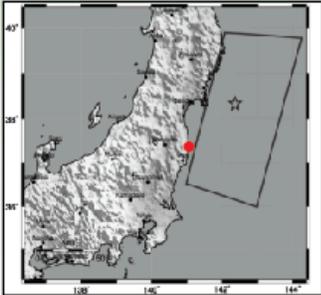


**Rikuzentakata City  
Iwate**



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## The Japan Earthquake from Space



**Fukushima Reactor  
Fukushima**



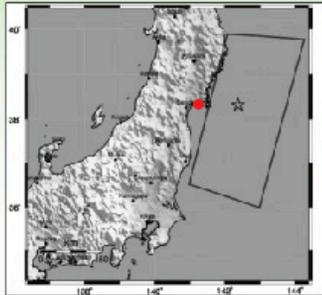
**Before**



**After**

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## The Japan Earthquake from Space



Ishinomaki City  
Miyagi



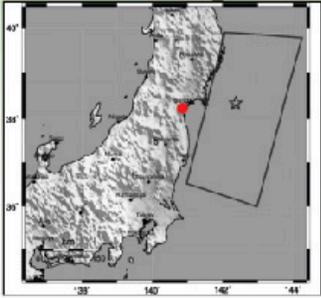
Before



After

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## The Japan Earthquake from Space



**Yuriage Town, Natori  
Miyagi**



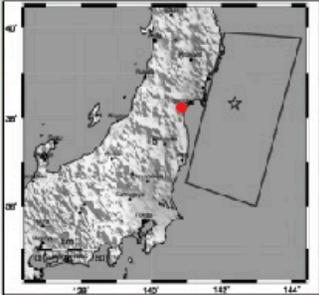
**Before**



**After**

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## The Japan Earthquake from Space



Sendai Airport, Natori  
Miyagi



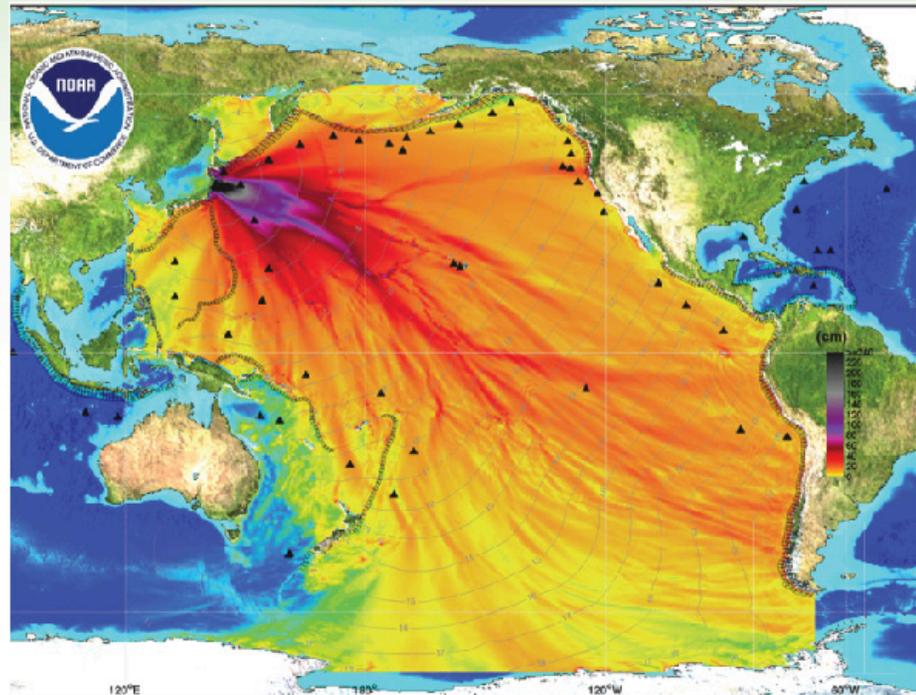
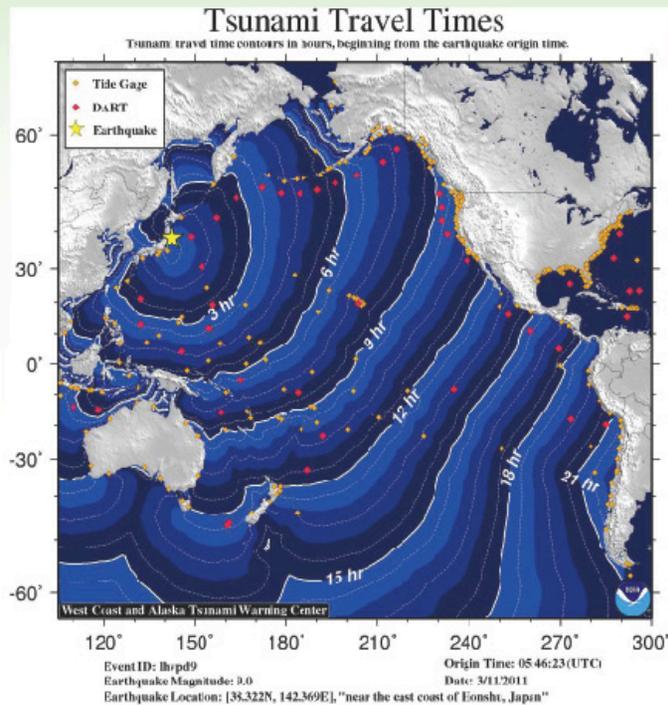
Before



After

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## The Japan tsunami affected all of the Pacific basin



The image to the left shows the time it took for the first waves to travel from the source region in Japan to other areas in the Pacific. The first surges arrived in Japan 20 minutes to an hour after the earthquake. The waves took almost a day to travel to Chile.

The image on the right is the modeled peak amplitudes of the tsunami surges. Notice the finger of amplification along the Northern California coast. Images from NOAA.

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## Impacts of the Japan Tsunami in California

**The first tsunami surges arrived on the Northern California Coast more than nine hours after the earthquake**

- A Tsunami Warning was issued for the California coast about three hours after the earthquake and six hours before the first surges arrived.
- An Warning means that there is a significant danger of flooding on dry land.

**The tsunami caused about 50 million dollars of damage on the California Coast**



*Crescent City Harbor during the tsunami.*



*The tsunami hitting Santa Cruz harbor.*



*The damage at Crescent City.*



*The tsunami entering the mouth of the Noyo River.*

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## The Japan tsunami on the West Coast

Crescent City



Brookings



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## Lessons from the Japan Earthquake Don't head to the coast to watch the tsunami



*A number of people headed to the banks of the Mad River to watch the tsunami.*



*This is what they were watching - a surge rushing up the river channel.*

All along the West Coast, most people did the right thing - they followed the advise of emergency personnel and left low-lying areas and harbors and stayed away until officials said it was safe to return. There were exceptions and unfortunately, one of the exceptions lost their life.

TSUNAMI

### California tsunami victim found washed ashore 380 miles away

April 12, 2011 | By Michael Martinez, CNN

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