A magnitude 8.3 earthquake struck off the coast of central Chile, generating a local tsunami of (≈ 4.5 m). The epicentre was centered about 46 km (≈ 29 miles) west of Illapel. The depth has been estimated to be about 10 – 20 km (≈ 6 – 12 miles).

At least eight fatalities have been recorded as a direct result of the earthquake. Other effects have included water/power cuts, damage to buildings and other infrastructure.
Shaking intensity: *Destructive* (VIII) to *very strong* shaking (VII) was felt in nearby coastal settlements to the north of the epicentre. *Very strong* shaking (VII) was experienced through most of Coquimbo. *Rather strong* (V) to *moderate* (IV) shaking was also reported in San Juan, Argentina and Santiago in central Chile.

### Shaking Intensity – Modified Mercalli Intensity Scale (MMI)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Instrumental</td>
<td>Not felt by many people unless in favourable conditions.</td>
</tr>
<tr>
<td>II. Weak</td>
<td>Felt only by a few people at best, especially on the upper floors of buildings. Delicately suspended objects may swing.</td>
</tr>
<tr>
<td>III. Slight</td>
<td>Felt quite noticeably by people indoors, especially on the upper floors of buildings. Many do not recognise it as an earthquake. Standing motor cars may rock slightly. Vibration similar to the passing of a truck. Duration estimated.</td>
</tr>
<tr>
<td>IV. Moderate</td>
<td>Felt indoors by many people, outdoors by a few people during the day. At night, some awakened.</td>
</tr>
<tr>
<td>V. Rather Strong</td>
<td>Felt outside by most, may not be felt by some people in non-favourable conditions. Dishes and windows may break and large bells will ring. Vibrations like train passing close to house.</td>
</tr>
<tr>
<td>VI. Strong</td>
<td>Felt by all; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight.</td>
</tr>
<tr>
<td>VII. Very Strong</td>
<td>Difficult to stand; furniture broken; damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by people driving motor cars.</td>
</tr>
<tr>
<td>VIII. Destructive</td>
<td>Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved.</td>
</tr>
<tr>
<td>IX. Violent</td>
<td>General panic; damage considerable in poorly designed structures, well designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.</td>
</tr>
<tr>
<td>X. Intense</td>
<td>Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundation. Rails bent.</td>
</tr>
<tr>
<td>XI. Extreme</td>
<td>Few, if any masonry structures remain standing. Bridges destroyed. Rails bent greatly.</td>
</tr>
<tr>
<td>XII. Cataclysmic</td>
<td>Total destruction – everything is destroyed. Lines of sight and level distorted. Objects thrown into the air. The ground moves in waves or ripples. Large amounts of rock move position. Landscape altered, or leveled by several meters. In some cases, even the routes of rivers are changed.</td>
</tr>
</tbody>
</table>
**Magnitude 8.3 ILLAPEL, CENTRAL CHILE**

**Wednesday, 16 September, 2015 at 22:54:33 UTC**

### Hazard alert status

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 Fatalities

<table>
<thead>
<tr>
<th>MMI</th>
<th>Shaking</th>
<th>Pop.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Not Felt</td>
<td>_ _</td>
</tr>
<tr>
<td>II-III</td>
<td>Weak</td>
<td>_ _</td>
</tr>
<tr>
<td>IV</td>
<td>Light</td>
<td>1,040k*</td>
</tr>
<tr>
<td>V</td>
<td>Moderate</td>
<td>6,698k*</td>
</tr>
<tr>
<td>VI</td>
<td>Strong</td>
<td>2,406k*</td>
</tr>
<tr>
<td>VII</td>
<td>Very Strong</td>
<td>836k</td>
</tr>
<tr>
<td>VIII</td>
<td>Severe</td>
<td>42k</td>
</tr>
<tr>
<td>IX</td>
<td>Violent</td>
<td>0k</td>
</tr>
<tr>
<td>X</td>
<td>Extreme</td>
<td>0k</td>
</tr>
</tbody>
</table>

### Estimated Economic Losses

- **USD Millions**
  - 1
  - 10
  - 100
  - 1,000
  - 10,000
  - 100,000

- **Percentages**
  - 4%
  - 21%
  - 41%
  - 27%
  - 6%

Images courtesy of the US Geological Survey.
Earthquake slip models

Right: A preliminary slip model generated by the USGS from seismic data. The model suggests most of the slip occurred to the NW of the epicentre (up to 9m of displacement).

Above: A graph displaying total energy release over time for the rupture. The most energy release occurred between 40-60 s after the start of the earthquake.

Images courtesy of US Geological Survey.
Tectonic setting

After the Maule 2010 and Pisagua 2014 earthquakes of magnitude Mw 8.8 and Mw 8.2 respectively, an important earthquake of magnitude Mw 8.4 occurred on the 16th of September 2015 in the Chilean subduction zone, in South America. The rupture area of this earthquake occurred roughly between these two earlier subduction zone earthquakes. The earthquake had a thrusting mechanism similar to the 2010 and 2014 earthquakes.

These thrusting earthquakes are caused as the Nazca tectonic plate subducts under the South-American continental plate at a convergence rate of 6.6cm/year.
Earthquakes from space

In a mega thrust earthquake like this, the overriding continental plate moves upwards, causing a Tsunami (see next slide). This movement of the plate is also measurable from space, as shown in the image on the right.

The satellite measures the height of the earth surface by bouncing radio waves off the surface. At least 50 ‘fringes’ can be seen from the Sentinel-1 interferogram, representing at least 140 cm of displacement in the satellite’s looking direction.
This event also triggered a tsunami that reached heights of up to 4 meters in the Coquimbo bay area, north of the Capital Santiago, and damaged some of the ports in the littoral area of the Chilean coast.

A tsunami alert for the whole Pacific area was sent some minutes after the earthquake and more than a million people were evacuated from coastal areas of Chile.
That was in big part thanks to the deployment of important seismic networks that are recording and transmitting data in real time, allowing seismologists to give the alerts to the community very quickly.

Seismic and Tsunami Alerts:

Despite the fact that cities such as Illapel or Coquimbo were affected by strong shaking during the earthquake, the damage was moderate in comparison to other events of same size around the world.
This last important earthquake in this area occurred in the same zone in 1943, and broke with a magnitude 8.2 producing wide spread damage. Geodetic studies show a region with a high coupling between the Nazca and South American tectonic plates (See Fig). That means that the surface between the plates was partially locked, and potentially has been for more than 70 years. This energy is then released in around only 70 seconds, the duration of the earthquake.
Magnitude 8.3 ILLAPEL, CENTRAL CHILE

Wednesday, 16 September, 2015 at 22:54:33 UTC

Seismic waves recorded in the UK

- Even though the earthquake occurred more than 10,000 km (~6,800 miles) from the UK, the seismic waves emitted by this earthquake can still be measured.
- The plot above shows the vertical component of the seismic waves measured at seismic stations across the UK. The colour of the line corresponds to the station at which it was recorded, shown on the map on the left hand side of the slide.
Magnitude 8.3 ILLAPEL, CENTRAL CHILE

Wednesday, 16 September, 2015 at 22:54:33 UTC

Find out more....

- BGS (British Geological Survey) – seismology and earthquakes – frequently asked questions http://www.earthquakes.bgs.ac.uk/education/faqs/faq_index.html

- IRIS (Incorporated Research Institutions for Seismology) – learning about earthquakes http://www.iris.edu/hq/programs/education_and_outreach/students

- UK School Seismology Project – classroom activities, videos and support documents http://www.bgs.ac.uk/schoolseismology/home.html

- USGS (United States Geological Survey) – FAQs, glossary, posters, animations http://earthquake.usgs.gov/learn/