EUROPEAN COMMISSION
DIRECTORATE GENERAL JRC
JOINT RESEARCH CENTRE
Institute for the Protection and Security of the Citizen
Global Security and Crisis Management Unit
CriTech

Saturday, 27 February 2010

Tsunami and earthquake in Chile

Chile, 27 February 2010

TS-2010-000035-CHL, EQ-2010-000034-CHL

Executive Summary

On 2/27/2010 6:34:17 AM UTC an earthquake of magnitude 8.3 and depth 59.4km has struck an moderately populated area in the Bio-Bio Province (population: 1.7 million) in Chile. GDACS estimates the likelihood for need of international humanitarian intervention to be high (Red alert).

The earthquake 116km from the city of Concepción. The nearest populated places are Ramadillas (19km), Canelillos (16km), Trogualemo (16km), Molinos (11km), Las Quilas (13km), Chevelle (7km), Curanipe (4km), La Matanza (20km), Las Lomas (9km), Infiernillo (12km), Lagunillas (19km), Chanco (16km). It is a hilly region with a maximum altitude of 796 m.

A tsunami was generated with a confirmed height of 1.5m near the epicentre (tidal readings). Calculations predict wave over 4m at the coast, affecting major towns of Conceptión (4.3m) and Constitución (4.3m). The tsunami propagates in the Pacific, but the risk for Pacific Islands is considered to be low (travel time is around 10h).

Situation

Event alert (GDACS)

The estimation of the location and magnitude of the earthquake varied a lot in the first hours. Therefore, tsunami wave heights varied too.

Figure 1. Various estimates of the epicentre in the first 2 hours.

Earthquake report	Tsunami report	Event Date/Time	Lat/Lon	Magnitude	Depth (km)	Source	Publication Date/Time	Delay
78809		2/27/2010 6:34:13 AM UTC	-36.1, -72.6	8.5	55	NOAA (at00725245)	2/27/2010 6:57:37 AM UTC	23min
78810	1852 (Max. wave at coast: 0.05m)	2/27/2010 6:34:14 AM UTC	-36.27, -72.92	6.8	60	EMSC	2/27/2010 6:57:38 AM UTC	23min
78813	1857 (Max. wave at coast: 1.07m)	2/27/2010 6:34:11 AM UTC	-36.04, -72.93	7	10	EMSC	2/27/2010 7:07:44 AM UTC	33min
78815	1855 (UNESCO matrix)	2/27/2010 6:34:17 AM UTC	-35.8263, -72.6686	8.3	59.4	NEIC (us2010tfan)	2/27/2010 7:17:25 AM UTC	43min
78817		2/27/2010 6:34:16 AM UTC	-35.89, -72.78	8.3	0	EMSC	2/27/2010 7:29:17 AM UTC	55min
78821	1860 (UNESCO matrix)	2/27/2010 6:34:14 AM UTC	-35.8464, -72.7189	8.8	35	NEIC (us2010tfan)	2/27/2010 7:57:38 AM UTC	83min

More information: see
http://www.gdacs.org/reports.asp?eventType=EQ&ID=78815&system=asgard&location=CHL&alertlevel=Red&glide_no=TS-2010-000035-CHL&TsID=1855&datetime=20100227&groupid=78809

Aftershocks

Several aftershocks occurred, with magnitudes above 6M, most likely further affecting damaged buildings in the affected area.

Affected area and population

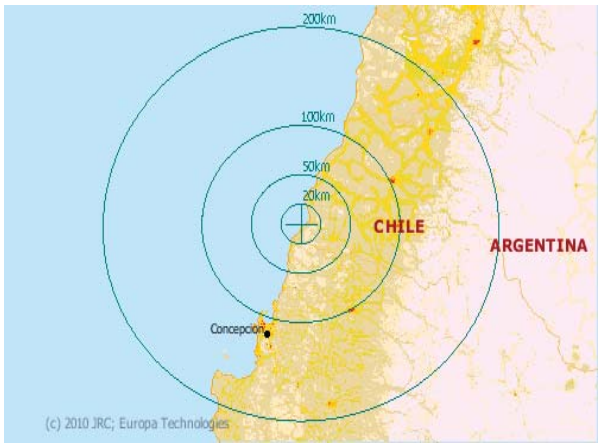

Figure 2. Population density in affected area

Radius (km)	Population	Density (people/km²)
1	0	0
2	0	0
5	1270	16
10	4032	12
20	10961	8
50	84252	10
100	630242	20
200	3010499	23

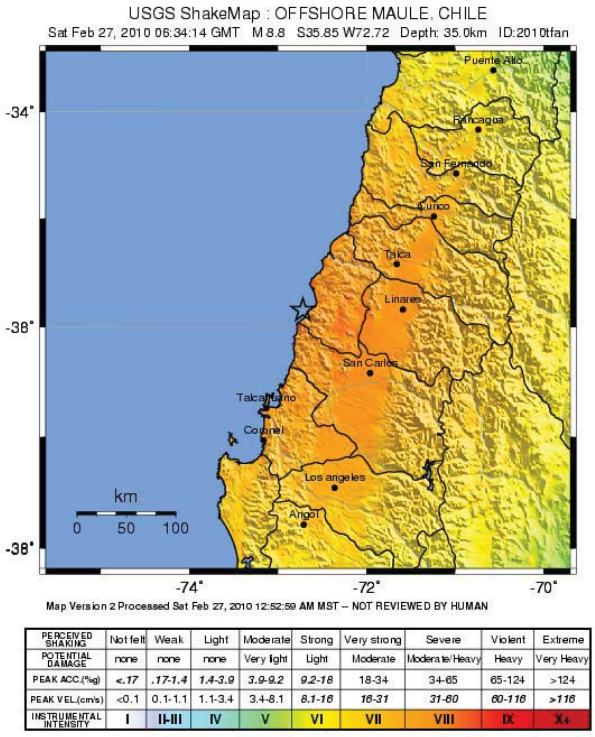

Figure 3. USGS NEIC Shakemap, showing the intensity zones up to VIII.

Tsunami impact

Calculations

The JRC tsunami calculation system uses pre-calculated scenarios and real-time calculations to estimate wave height and arrival time of the tsunami wave in various locations. The results of the calculations depend on the estimates of the location and magnitude of the earthquake, which are revised regularly by seismological institutes.

Validation

Ocean surface wave buoys and deep pressure buoys record tsunami waves. There is are several local surface wave buoys located near the epicentre. The nearest buoy (Talcahuano), located more or less on the epicentre, recorded a wave of 1.5m. IOC reports a reading at Valparaiso (20 minutes after the event) of 1.29m.

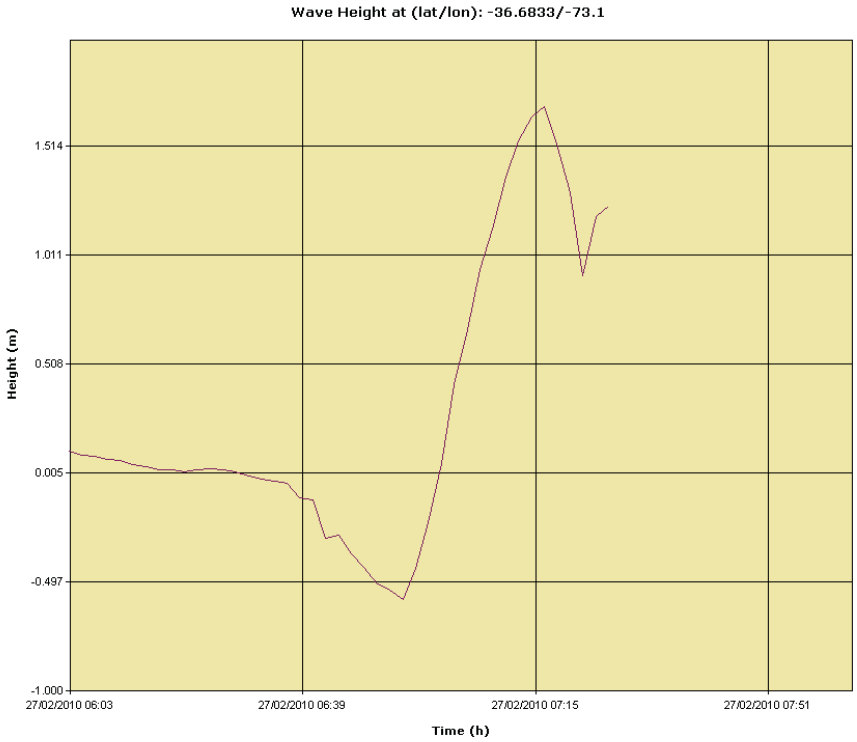

Figure 4. Readings at Talcahuano gauging station indicate a wave of over 1.5m.

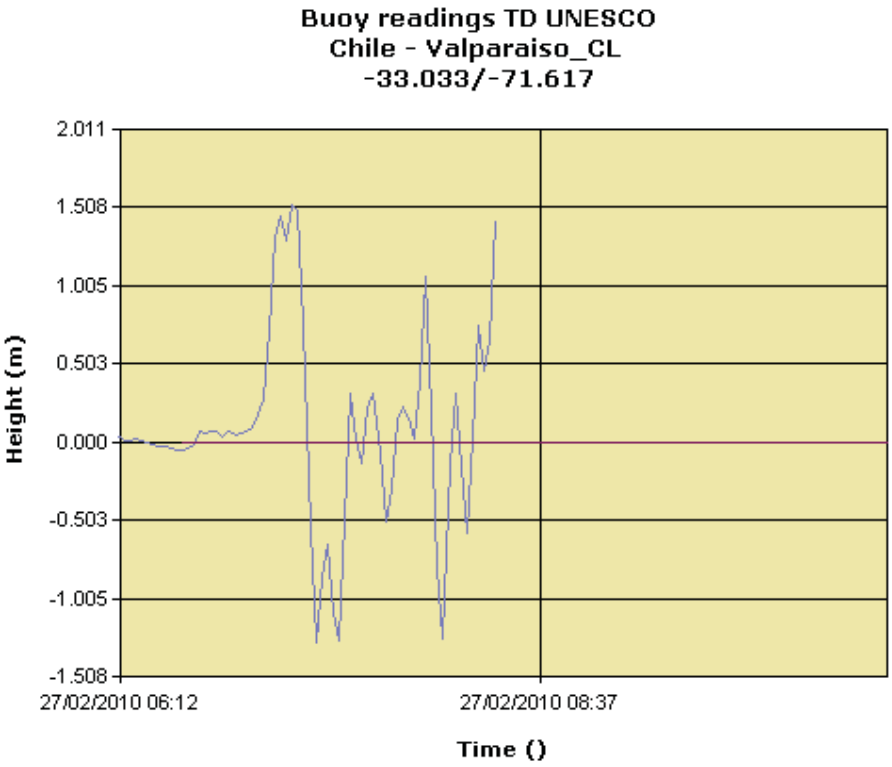

Figure 5. Readings at Valparaiso gauging station indicate a wave of about 1.5m.

Further buoys should have recorded the tsunami by the time of writing of this report, but the latest readings were transmitted at 7:29UTC, i.e. before the tsunami would reach the buoys.

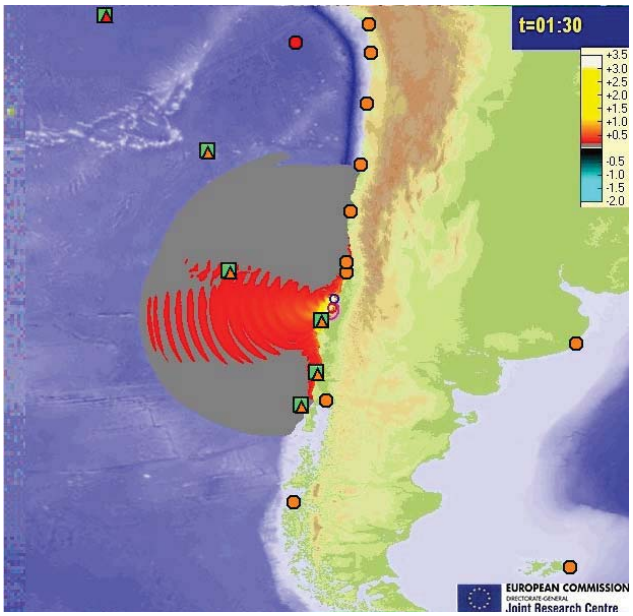

Figure 6. Location of buoys. The dart buoys are the red triangle and red dot on the top of the image. Surface water gauging buoys are orange dots or triangles. The image represents the maximum measured height calculated with the JRC SWAN code.

The first DART buoy will be reached at 9:47UTC. At that time, the tsunami wave propagation towards the Pacific can be confirmed.

List of calculated affected places, arrival times

Based on a magnitude of 8.3 and location of -38.8263, -72.6686, the following places are affected according to the JRC tsunami propagation calculations.

Actual Time	Location	Country	Height (m)	Pop. estimate	Class
27/02/2010 06:34:00	La Pita	Chile	3.2		6
27/02/2010 06:34:00	Chanco	Chile	3.7		6
27/02/2010 06:34:00	Arinia	Chile	3.7		6
27/02/2010 06:34:00	Colmuyao	Chile	4.0		6
27/02/2010 06:34:00	Las Quilas	Chile	3.7		6
27/02/2010 06:34:00	QuilquTn	Chile	3.2		6
27/02/2010 06:34:00	Las Delicias	Chile	2.0		6
27/02/2010 06:34:00	Taimo	Chile	2.0		6
27/02/2010 06:34:00	Cielo	Chile	4.2		5
27/02/2010 06:34:00	Pichihuedque	Chile	0.5		6
27/02/2010 06:34:00	Mellinto	Chile	4.0		6
27/02/2010 06:34:00	Cha±ihue	Chile	4.1		6
27/02/2010 06:34:00	Los Corrales	Chile	2.5		6
27/02/2010 06:34:00	Culenco	Chile	1.3		6
27/02/2010 06:34:00	El Roble	Chile	0.7		6
27/02/2010 06:34:00	Buchupureo	Chile	4.4		5
27/02/2010 06:34:00	Pullay	Chile	4.5		6
27/02/2010 06:34:00	Bellavista	Chile	4.4		6
27/02/2010 06:34:00	Quile	Chile	4.2		6
27/02/2010 06:34:00	Ramadillas	Chile	4.2		6
27/02/2010 06:34:00	La Leonera	Chile	0.3		6
27/02/2010 06:34:00	Frutillar	Chile	4.2		6
27/02/2010 06:34:00	Menque	Chile	3.5		6
27/02/2010 06:34:00	Concepción	Chile	4.3	213213	2
27/02/2010 06:34:00	Fresia	Chile	3.3		6
27/02/2010 06:34:00	AndaliTn	Chile	4.3		6
27/02/2010 06:34:00	Hualpencillo	Chile	4.3		6
27/02/2010 06:34:00	La Boca	Chile	4.3		6
27/02/2010 06:34:00	Cerro Verde	Chile	4.0		6
27/02/2010 06:34:00	Roa	Chile	0.8		5
27/02/2010 06:34:00	Juan Chico	Chile	1.4		6
27/02/2010 06:34:00	TomT	Chile	4.3	51418	4
27/02/2010 06:34:00	Tres Esquinas	Chile	3.3		5
27/02/2010 06:34:00	Dichato	Chile	4.2		5
27/02/2010 06:34:00	Cajón de Mela	Chile	3.8		6
27/02/2010 06:34:00	Pissis	Chile	1.9		6
27/02/2010 06:34:00	Los Morros	Chile	4.2		5
27/02/2010 06:34:00	Guarilihue	Chile	1.8		6
27/02/2010 06:34:00	Coelemu	Chile	0.4		4
27/02/2010 06:34:00	Boca de Itata	Chile	4.1		5
27/02/2010 06:34:00	Vegos de Itata	Chile	4.1		5
27/02/2010 06:34:00	Pua·n	Chile	3.8		6
27/02/2010 06:34:00	Illoquilque	Chile	1.0		5
27/02/2010 06:34:00	Trogualemo	Chile	4.5		5
27/02/2010 06:34:00	Rafael	Chile	1.9		5
27/02/2010 06:34:00	Los Espinos	Chile	3.2		6
27/02/2010 06:34:00	Coronel	Chile	0.5		6
27/02/2010 06:34:00	La Puente	Chile	2.2		6

Actual Time	Location	Country	Height (m)	Pop. estimate	Class
27/02/2010 06:34:00	Agua Buena	Chile	0.8		6
27/02/2010 06:34:00	Junquillar	Chile	4.3		6
27/02/2010 06:34:00	Ca±ete	Chile	2.7		6
27/02/2010 06:34:00	Carrizal	Chile	2.7		6
27/02/2010 06:34:00	Los Quillayes	Chile	1.4		6
27/02/2010 06:34:00	Cabeza de Vaca	Chile	1.4		6
27/02/2010 06:34:00	Constitución	Chile	4.3	45597	4
27/02/2010 06:34:00	Calabozo	Chile	3.2		6
27/02/2010 06:34:00	Los Huesos	Chile	1.6		6
27/02/2010 06:34:00	Carrizalillo	Chile	2.0		6
27/02/2010 06:34:00	Guilleumo	Chile	3.6		6
27/02/2010 06:34:00	Chanquiuque	Chile	2.5		5
27/02/2010 06:34:00	Peralillo	Chile	2.5		6
27/02/2010 06:34:00	Loma Blanca	Chile	0.7		6
27/02/2010 06:34:00	Huelón	Chile	1.9		6
27/02/2010 06:34:00	Comunidad El Guapi	Chile	1.9		6
27/02/2010 06:34:00	Casas Fundo El MTdano	Chile	1.9		6
27/02/2010 06:34:00	El Peral	Chile	4.0		6
27/02/2010 06:34:00	Coihueco	Chile	2.1		6
27/02/2010 06:34:00	Canelillos	Chile	4.3		6
27/02/2010 06:34:00	Chevelle	Chile	4.3		5
27/02/2010 06:34:00	Molinos	Chile	3.8		6
27/02/2010 06:34:00	PilTn	Chile	0.3		5
27/02/2010 06:34:00	Curanipe	Chile	4.1		6
27/02/2010 06:34:00	Las Lomas	Chile	3.7		5
27/02/2010 06:34:00	La Matanza	Chile	1.5		6
27/02/2010 06:34:00	La Ovejerfa	Chile	3.3		6
27/02/2010 06:34:00	Lagunillas	Chile	3.2		6
27/02/2010 06:34:00	San Antonio	Chile	4.3		6
27/02/2010 06:34:00	Chacarilla	Chile	0.1		6
27/02/2010 06:34:00	Tejerfa	Chile	2.6		6
27/02/2010 06:34:00	Molco	Chile	0.8		6
27/02/2010 06:34:00	Carreras Cortas	Chile	3.6		6
27/02/2010 06:34:00	Pahuil	Chile	3.9		6
27/02/2010 06:34:00	Los Tablones	Chile	3.5		5
27/02/2010 06:34:00	Empedrado	Chile	1.2		5
27/02/2010 06:34:00	Loanco	Chile	4.5		5
27/02/2010 06:34:00	Pellfn	Chile	3.0		6
27/02/2010 06:34:00	Huillfn	Chile	0.4		6
27/02/2010 06:34:00	Infiernillo	Chile	3.7		6
27/02/2010 15:37:38	El Portón	Chile	4.5		6
27/02/2010 15:37:38	Quiriguina I	Chile	4.5		5
27/02/2010 15:37:38	Talcahuano	Chile	4.4	247951	4
27/02/2010 15:37:38	San Vicente	Chile	4.4		6

Overview of response (GDACS)

The Virtual OSOCC was active 30 minutes after the earthquake. A dedicated page was created at 7:21UTC (50 minutes after the event).

There are reports of black-out in Santiago.

References

For updated information on the disaster, please consult the following web sites:

- http://www.gdacs.org: Global Disaster Alert and Coordination System
- http://mic-env.jrc.it: MIC Portal