CHILE EARTHQUAKE AND TSUNAMI ON 27 FEBRUARY 2010

Fourth United Nations International UN-SPIDER Bonn Workshop on Disaster Management and Space Technology 12 – 14 October 2010
- Date: February 27, 2010
- Time: 03:34 UTC
- Magnitude: 8.8 Richter
- Coord. Epicentre: 36° 12′28″ S / 72° 57′46″ W
- Side Effects: Tsunami between Llolleo (V Region) and Puerto Saavedra (IX Region)
- Affected Areas in Chile:
  - Región de Valparaíso
  - Región Metropolitana
  - Región de O'higgins
  - Región del Maule
  - Región del Biobío
  - Región de la Araucanía
- Victims: 497 dead, 56 missing
The earthquake occurred at 3:34:17 local time in Chile and subsequent Tsunami, on Saturday February 27, 2010.

The most affected areas by the earthquake were the Regions of Valparaíso, Metropolitana - Santiago, O'Higgins, Maule, Bío-Bío and La Araucanía, who accumulate more than 13 million people (about 80% of the population). In the regions of Maule and Bio Bio, the earthquake had its greatest intensity, destroying much of the cities as: Constitution, Concepción, Cobquecura and part of Talcahuano.
The earthquake reached a magnitude of 8.8 Richter scale; The epicenter was located at sea, opposite to the towns of Curanipe and Cobquecura, about 93 miles northwest of Concepción and 39 miles southwest of Cauquenes, and 47.4 kilometers beneath Earth's crust, with an approximate duration of 2 minutes and 45 seconds.
In the regions of La Araucanía, O'Higgins and Metropolitan - Santiago, the earthquake measured an intensity of 8.4 causing major destruction in the capital, Santiago de Chile, in Rancagua and rural locations.

The death toll come to a total of 497 people. About 500 thousand homes were left with severe damage and total of estimated a 2 million victims; in this way, the earthquake 27F is set up as the worst natural disaster experienced in Chile since 1960.
Due to the intensity of the seismic, hours after a strong earthquake tsunami struck the coasts of Chile as a result of the seismic movement, destroying several villages devastated by the quake impact. The Juan Fernández archipelago, despite not feeling the quake, was hit by tidal waves that swept its only town, San Juan Bautista. A tsunami warning was generated for the Pacific Ocean was later extended to 53 countries located along much of its basin, reaching Peru, Ecuador, Colombia, Panama, Costa Rica, Nicaragua, New Zealand, French Polynesia and coastal Hawaii.
Chile Space Agency
Agencia Chilena del Espacio
MULTISEQUENTIAL WORKING GROUP GEOGRAPHICAL INFORMATION

Earthquake and Tsunami in Chile – February 27, 2010

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1. On February 27th, ONEMI made the necessary arrangements for the activation of the "International Charter on Space and Major Disasters" CHARTER. In turn, simultaneously, UNOOSA, and CONAE UNOSAT triggered the same instrument, with the latter at the request of ONEMI. This effort was supported by the ACE.

2. Due to activating CHARTER, was appointed, a professional of Civil Protection Division of ONEMI, as Project Manager (PM) for this event. Therefore, this professional is responsible for the information and its use obtained hereby.

3. At the same time, the ACE asked different agencies and international companies supported by satellite images of the disaster area, taking immediate response from Spot Image, which contact became effective by EADS-Astrium, the company which Chile bought the satellite earth observation.
4. Several national and international institutions have made offers of satellite images for the assessment of impacts and subsequent stages of rehabilitation and reconstruction. Among the offerings must be mentioned the German Space Agency (DLR), CONAE of Argentina, USGS (U.S. Geological Survey), CNES of France, ESA, ESRI.

5. Once constituted GTMIG working group, which was installed in the premises of ONEMI, it was agreed to designate as coordinator, the current to Executive Secretary of the Chilean Space Agency, in order to organize the work.

6. Prepare a memorandum of understanding, for directors of public institutions represented in the GTMIG, for to formalization of this group which promotes proper function and allow appropriate action when an emergency situation occurs, which can be affecting the country, as required. This protocol was developed and will be discussed at a forthcoming meeting of the directors of the participating institutions, awaiting his next signing as soon as possible.
MULTISECTORAL WORKING GROUP
GEOSPATIAL INFORMATION
2010
MULTISECTORAL WORKING GROUP
GEOSPATIAL INFORMATION

ONEMI
Institution to coordinate emergency activities in Chile

ACE
Coordinator of the activities of international management of geospatial information

SAF
Institution of spatial data support airborne

SERNAGEOMIN
Intended to provide scientific support in matters of natural disasters

IGM
Institution in charge of mapping the country bases

CIREN
Institution in charge of the digital processing of satellite information

INE
Institution responsible for giving statistical information bases in the country

SNIT
Responsible for dissemination of information and activities prepared by the GTMIG
### Multi-Sectoral Working Group
#### Geospatial Information

#### Events prior to GTMIG

**February 27, 2010 – 3:45 AM**

| Earthquake and Tsunami in the regions V to IX of Chile |

**February 27 de 2010 – 5:00 AM**

| UN-SPIDER activated for the transmission of information to ONEMI |

**February 27 de 2010 – 5:00 AM**

| ONEMI with support from the ACE, select the “International Charter on Space and Major Disasters” CHARTER |

**February 27  28, 2010**

| The ACE coordinates with various agencies and international companies support of satellite imagery for Chile. |

**February 28, 2010**

| The ACE calls to different government agencies and services to work with the satellite data received from the disaster zone. |

**March 1, 2010**

| They get together different agencies to assist in the tasks of analysis and image processing in ONEMI |

**March 1, 2010**

| Complies formally, ONEMI units, the Multi-Sectoral Working Group Spatial Information (GTMIG), naming as general coordinator of Executive Secretary of ACE. |

**March 3 - April 1, 2010**

| Organizes a series of work for the use of images of the disaster area, giving direct support to the national, regional and local in emergency work. Subsequently, it began a phase of organization and institutionalization of the activities of GTMIG for future events. |
A count of the March 3, 2010, in office of the ONEMI, was formally set up the Working Group Multisectoral Spatial Information (GTMIG), to support, through the use of geospatial information, the authorities in charge of the tasks of planning and reconstruction after the earthquake and tsunami of February 27, 2010.
Objectives GTMIG

1. Coordinate the receipt of information from remote sensing (satellite imagery and aerial photos) with a basic processing that would support the decision making and provide inputs to other public sector to analyze it.

2. Coordinate the exchange of geospatial information between different public, private and academic.

3. Supporting the reconstruction planning by coordinating the work teams of national and international geospatial technologies.
1. In July 1999 conference held in Austria UNIESPACE III. It is a conference sponsored by the United Nations to promote the exploration and peaceful use of outer space. At that conference, the European Space Agency (ESA) and the French Space Agency (CNES) developed an "international bill" to provide satellite imagery in the context of emergencies and disasters, natural or man-made. In this way authorized users may request the mobilization of space resources and associated land bases from several satellites, including ERS, ENVISAT, SPOT, RADARSAT, IRS, SAC-C satellites of NOAA and LANSAT.

2. In Chile, following the events in the Lake District after the eruption of Chaitén Volcano, at the request of the Chilean Space Agency (ACE); ONEMI joins the International Charter Space and Major Disasters (Charter) for the use of Geospatial Information for Disaster and Emergency applications.

Agencias Espaciales miembros del Charter:

- Agencia Espacial Europea (ESA)
- Agencia Espacial Francesa (CNES)
- Agencia Espacial Canadiense (ASC)
- Administración Nacional del Océano y la Atmósfera de Estados Unidos (NOAA)
- Organización Espacial India (ISRO)
- Agencia Espacial Argentina (CONAE)
- Agencia Japonesa de Exploración Espacial (JAXA)
- Servicio Geológico de los Estados Unidos (USGS)
- Administración Nacional Espacial de China (CNSA)

Tipo de Imágenes entregadas:

- ERS
- ENVISAT
- SPOT
- RADARSAT
- IRS
- SAC-C
- NOAA
- LANDSAT
- ALOS
- ALOS
- DMC
(1) Occurrence of the disaster or emergency.
(2) Request for activation by authorized users and approved by the entities involved in the letter.
(3) Receipt of the call request. Here it is confirmed that the request is made by an authorized user; confirmed with the required information and transmits the information to the Emergency Service (ECO).
(4) Processes the information, verifies the validity of the request. Subsequently, it identifies the most appropriate satellite resource for emergency and assigns tasks to the most appropriate space agency.
(5) The agency procurement programs based on requests submitted, in turn, if necessary, suggest alternate acquisitions.
(6) The Project Manager coordinates the reception of images and makes new coordination sent if necessary.
(7) processes the images taken over and coordinates the activities necessary for the interpretation of data and preparation of additional maps (8) for shipment to end users in the planning of the tasks associated with the emergency (9)
Besides the immediate cooperation Geospatial Information provided by the CHARTER, the ACE achieving coordination with other international cooperation activities GTMIG.

German company that has a constellation of five satellites for earth observation, this contact was very important because it featured an image have 5-meter multispectral resolution of the greater part of the coast affected by the tsunami and was used to prepare Preliminary flood areas.

Direct contact between the Executive Secretary of the ACE and Pierre Duquesne, Latin America Sales Manager SPOT Image. The aid is translated into images, and SPOT sensors FORMOSAT, and implementation of Web platform to download images from the disaster area.

This international company, through its subsidiary ESRI - CHILE, facilitated GIS products for use in image processing activities of GTMIG.

Direct contact with Brenda Jones, in charge of emergency U.S. Geological Service, USGS. It coordinates cooperation in images of different formats, highlighting the Quickbird and Ikonos images.
Multi-Sectoral Working Group
Geospatial Information
Duty Cycle

RASTER DATA SOURCES (IMAGES)

SAF
CHARTER
OTHER SOURCES

OMEMI

Multi-Sectoral Working Group for Spatial Information

Professionals CIREN

Reception  Review  Handling and processing

Shipping to national, regional and local level:
- Ministerios
- Intendentes
- Jefes de plaza
- Alcaldes

Other processes and cross-based images. New Results
Stage I:
The first step was the activation, through ONEMI and the Chilean Space Agency (ACE), the International Charter "Space and Major Disasters" Charter, that allowed access to the corresponding servers to assemble the database satellite images needed for the activity of GTMIG. Added to this, the international coordinator of the ACE with other international agencies for sending satellite information to the disaster area.

Stage II:
This activity is divided into three parts:
- **Reception**: Entry into the servers of satellite images, activated by the Charter, and further accommodation in local servers ready for the work of GTMIG.
- **Review**: The process of revision, sorting and filtering the satellite images downloaded to the server.
- **Processing**: Final preparation (georeferencing) of images and preparation of tiles to cover the areas of interest (regional and local) to work procedures and analysis.
Stage III: In this first part, the work of GTMIG focuses on the areas affected by the action of the tsunami in the coastal areas, thus, this stage is the development of flood affected areas of these locations through the interpretation of satellite images available immediately after seismic activity.

Stage IV: After the delineation of floodplains is performed overlapping areas between the area flooded by the Tsunami and the mapping of population and housing available to the INE. The process can establish a technical and theoretical estimates of population and dwellings affected by the tsunami. In this way you can set the actions necessary assessment and planning.
Stage V:
The end product of the process is collected in databases and sent to national authorities, relevant regional and local action planning and evaluation of damage caused by seismic activity and tsunami of 27 last February. Furthermore, processed products are published on the portal of the National Information System of Territory (SNIT).
MULTI-SECTORAL WORKING GROUP
Geospatial Information
Description of institutional activities

TYPES OF IMAGES USED

Aerial Photography: High Resolution Camera DMC.

Optical Image: multiple sensors, the sample composition False color SPOT 5, Formosat panchromatic, etc.

Radar Image: SIASGE.

Cosmo – SkyMed - SAOCOM
Multi-Sectoral Working Group
Geospatial Information
First thematic products
Multi-Sectoral Working Group
Geospatial Information
First thematic products

Planimetry SAF

Cauquenes
Dichato
Parral

Linares
Concepción
Tirúa
First thematic products
Flood Areas
Multi-Sectoral Working Group
Geospatial Information
First thematic products
Constitución
VII Región del Maule
Área Afectada por Tsunami

Multi-Sectoral Working Group
Geospatial Information
First thematic products
Multi-Sectoral Working Group
Geospatial Information
First thematic products
One of the main conclusions of the work that resulted in the emergence GTMIG Earthquake is the need to have a multidisciplinary task force, highly trained in the use of geospatial information technologies that support in the preparation of thematic information, to emergency services and the authorities responsible for planning efforts and subsequent reconstruction.

Because of this, the Chilean Space Agency is currently preparing a memorandum of understanding for managers of public bodies represented in the GTMIG, for formal formalization of this group that favors their proper functioning and allow timely action when the situation emergency, which might be affected the country requires.

For this, we need to consider the following institutions:

- **SAF**
  - Institution spatial data support airborne

- **ONEMI**
  - Institution coordinate emergency activities in Chile

- **ACE**
  - Coordinator of the activities of international management of geospatial information

- **IGM**
  - Institution in charge of mapping the country bases

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- **SERNAGEOMIN**
  - Intended to provide scientific support in matters of natural disasters

- **INE**
  - Institution responsible for giving statistical information bases in the country

- **SNIT**
  - Responsible for dissemination of information and activities prepared by the GTMIG
Thus, through the institutional commitment is the protocol of agreement, is expected to:

1. Coordinate the receipt of information obtained through remote sensing (satellite imagery and aerial photos) with a process to support decision making and provide inputs to other public bodies for sectoral analysis in the risk management cycle.

2. Coordinate the exchange of geospatial information between different public, private and academic, in the different stages of risk management.

3. Supporting the reconstruction planning coordinating work teams national and international geospatial technologies.

4. Produce relevant and useful to integrate satellite imagery, aerial photography, geospatial data with demographic, housing and others, through stable and permanent maintenance of the work of the Working Group on Geospatial Information multisectoral, allocating human and material resources for it.

5. Finally, the undersigned institutions will commit to working a Memorandum of access, distribution and sharing of relevant information.
The experience acquired Chile's earthquake February 27, 2010, encourages countries in the world to build under the eaves of a national organization for those purposes a group of highly trained multidisciplinary work, Geospatial Information "GTMIG" to help substantially in the use of geospatial information technologies to support in the preparation of thematic information, emergency services and the authorities responsible for planning efforts and subsequent reconstruction.
Recognize the excellent work of Chile in the use of space technology to support disaster management, particularly on the occasion of the earthquake of February 27, 2010. Chile is asked to arbitrate the means to share this valuable experience with other countries in the Americas and the Caribbean.
Thank you very much

and

Chilean Space Agency

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Grupo de Trabajo Multisectorial de Información Geoespacial
Terremoto 2010
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Terremoto 2010

Centro de Temuco, IX Región - Chile

Hospital Regional, IX Región - Chile

Chile
EFECTOS DEL TSUNAMI EN LAS COSTAS DE CHILE
Grupo de Trabajo Multisectorial de Información Geoespacial
Terremoto 2010

ILOCA
Grupo de Trabajo Multisectorial de Información Geoespacial
Terremoto 2010
Grupo de Trabajo Multisectorial de Información Geoespacial

Terremoto 2010

PELLUHUE
Grupo de Trabajo Multisectorial de Información Geoespacial
Terremoto 2010
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CONSTITUCIÓN
Thank you very much

and

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