

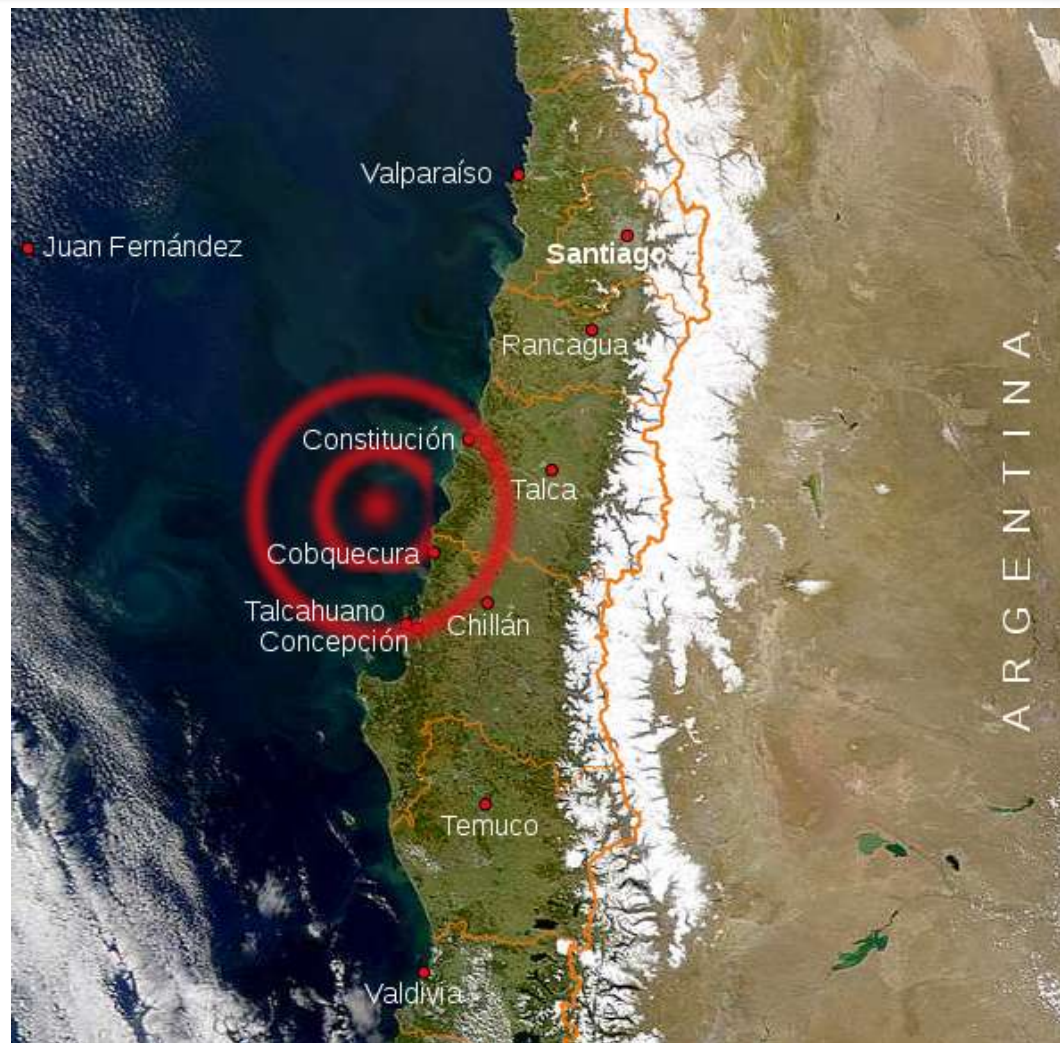
# CHILE EARTHQUAKE AND TSUNAMI ON 27 FEBRUARY 2010

Fourth United Nations International  
UN-SPIDER Bonn Workshop on Disaster  
Management and Space Technology  
12 – 14 October 2010



# Multi-Sectoral Working Group Geospatial Information 2010 Earthquake

- Date: **February 27, 2010**
- Time: **03:34 UTC**
- Magnitude: **8.8 Richter**
- Coord. Epicentre:  
 **$36^{\circ} 12'28'' S / 72^{\circ} 57'46'' W$**
- Side Effects: **Tsunami between Lolleo (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**



# Multi-Sectoral Working Group Geospatial Information 2010 Earthquake

- 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: Constitución, Concepción, Cobquecura and part of Temuco.



# CHILE EARTHQUAKE AND TSUNAMI IN FEBRUARY 27/2010

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.



# CHILE EARTHQUAKE AND TSUNAMI IN FEBRUARY 27/2010

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.



# Multi-Sectoral Working Group

## Geospatial Information

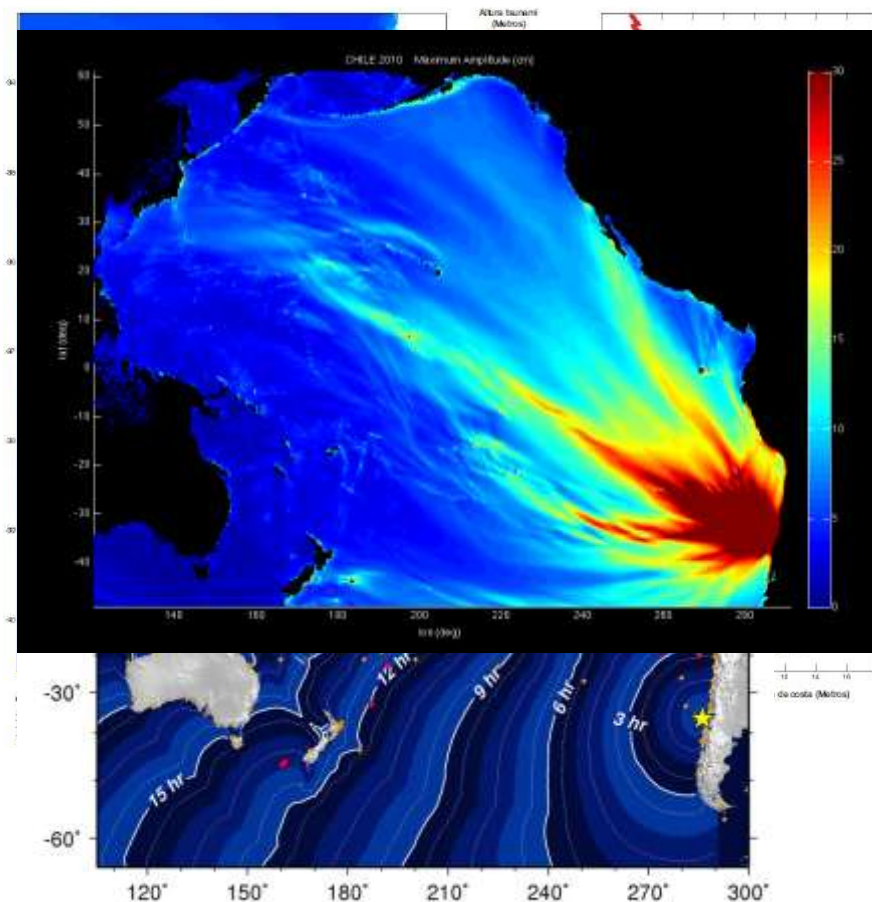
### 2010 Tsunami

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.

MODELACIÓN DEL TSUNAMI DEL 27 DE FEBRERO DE 2010, CHILE  
Resultados preliminares

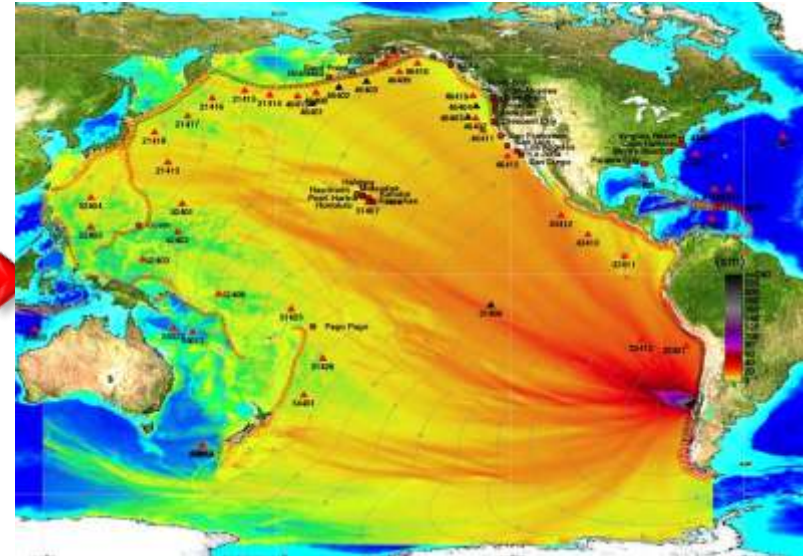
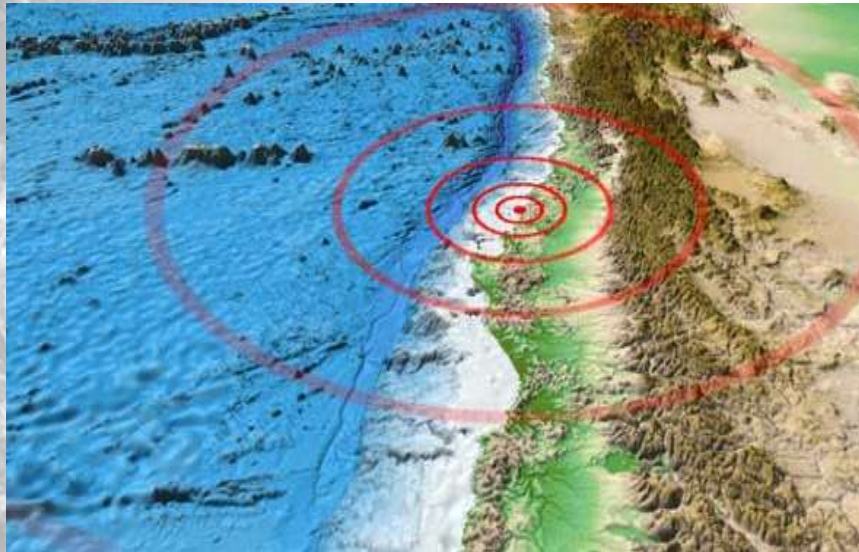


GMT 2010 Feb 27 11:57:25 UTC

## Chile Space Agency Agencia Chilena del Espacio

### MULTISECTORAL WORKING GROUP GEOSPATIAL INFORMATION

#### Earthquake and Tsunami in Chile – February 27, 2010



Fourth United Nations International  
UN-SPIDER Bonn Workshop on Disaster  
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# Multi-Sectoral Working Group

## Geospatial Information

### Background

#### **MULTISECTORAL WORKING GROUP GEOSPATIAL INFORMATION**

#### **Earthquake in Chile - February 27, 2010 (3:45 local time)**

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.



# Multi-Sectoral Working Group

## Geospatial Information

### Background

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 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 28, 2010

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

March 1, 2010

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

February 27 de 2010 – 5:00 AM

UN-SPIDER activated for  
the transmission of  
information to ONEMI

February 28, 2010

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

February 27 de 2010 – 5:00 AM

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

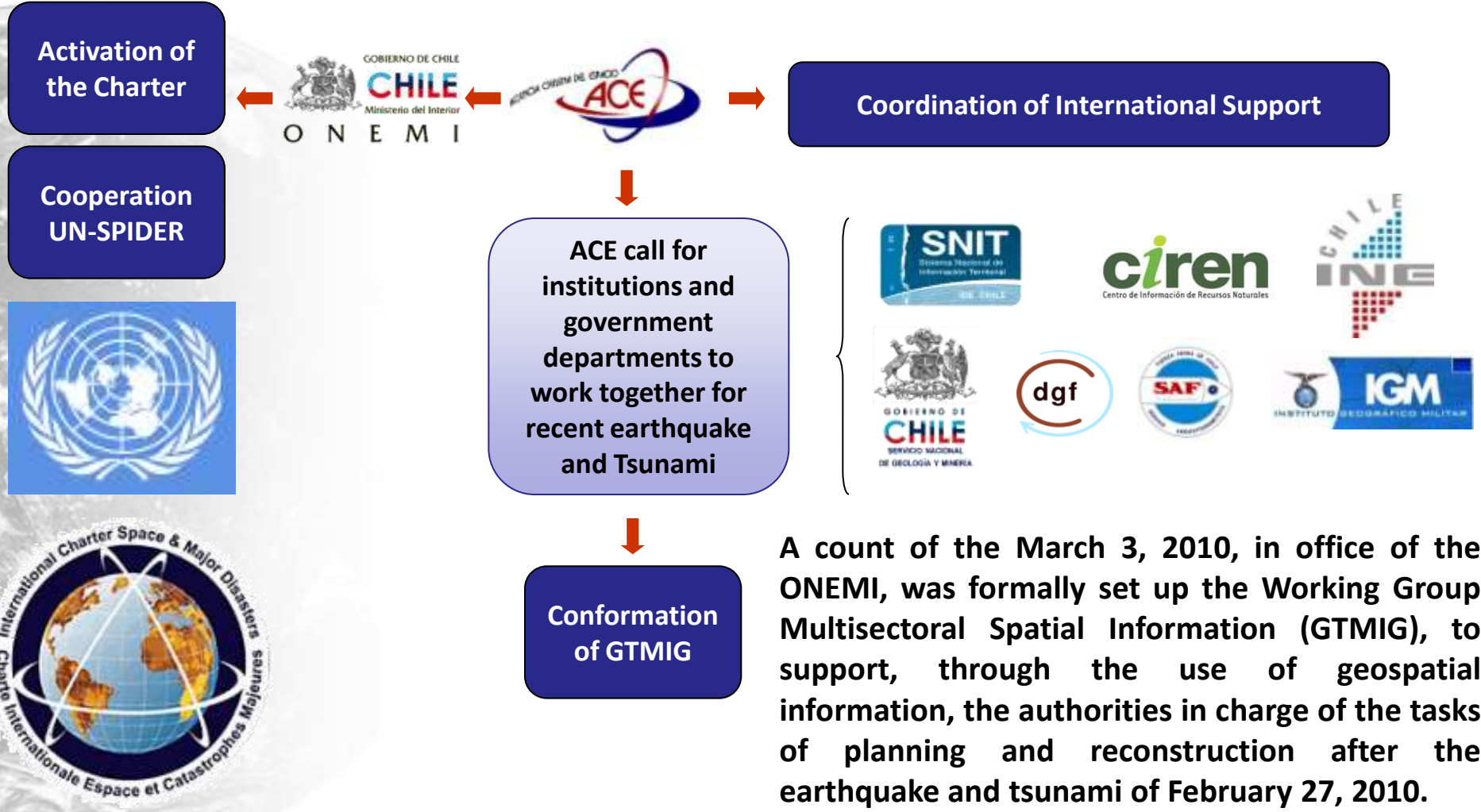
March 1, 2010

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

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.

# Multi-Sectoral Working Group Geospatial Information Conformation Scheme



## 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



# Multi-Sectoral Working Group Geospatial Information International Charter Space and Major Disasters

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:

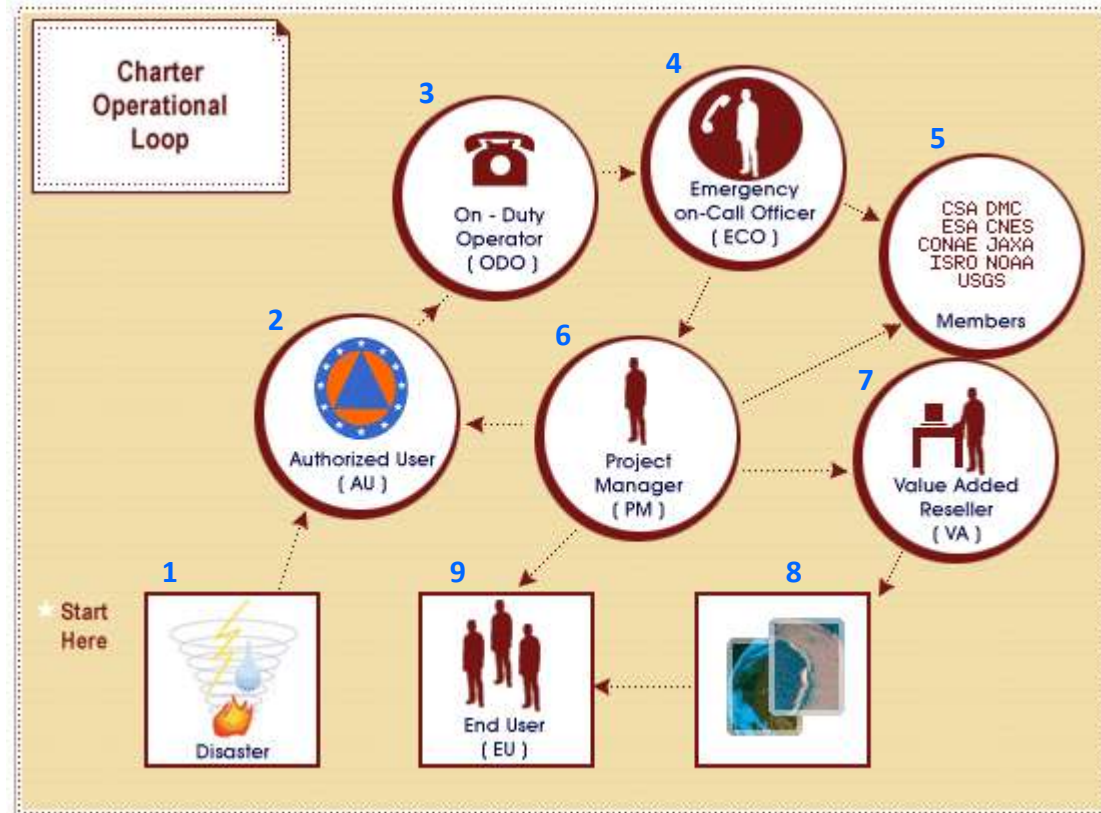
- ERS
- ENVISAT
- SPOT
- RADARSAT
- IRS
- SAC-C
- NOAA
- LANDSAT
- ALOS
- DMC



# Multi-Sectoral Working Group Geospatial Information International Charter Space and Major Disasters

- (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)

## Activation cycle Charter:





## Multi-Sectoral Working Group Geospatial Information International Cooperation

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.

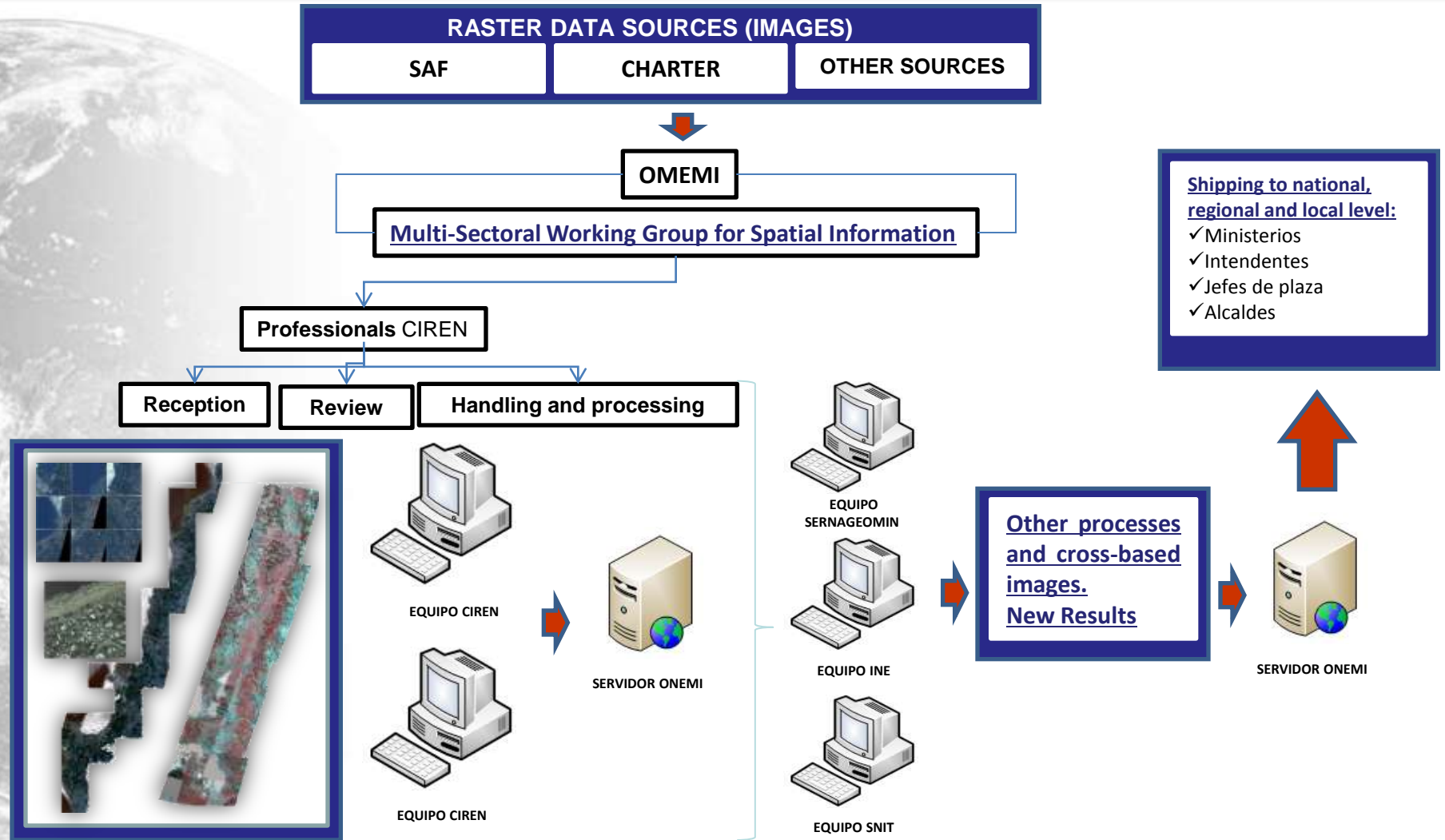


Direct contact with Brenda Jones, in charge of emergency U.S. Geological Service, USGS. It coordinates cooperation in images of different formats, highlighting the Quickbird and Ikonos images.



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

# Multi-Sectoral Working Group Geospatial Information Duty Cycle



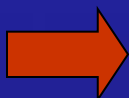
# Grupo de Trabajo Multisectorial de Información Geoespacial

## Duty Cycle - Overview

### 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:

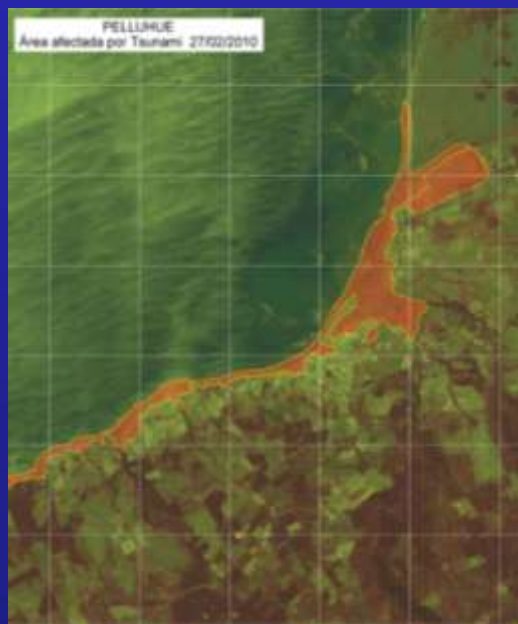
- Reception: Entry into the servers of satellite images, activated by the Charter, and further accommodation in local servers ready for the work of GTMIG.
- Review: The process of revision, sorting and filtering the satellite images downloaded to the server.
- Processing: Final preparation (georeferencing) of images and preparation of tiles to cover the areas of interest (regional and local) to work procedures and analysis.



## Grupo de Trabajo Multisectorial de Información Geoespacial Ciclo de Trabajo - Descripción

### 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:

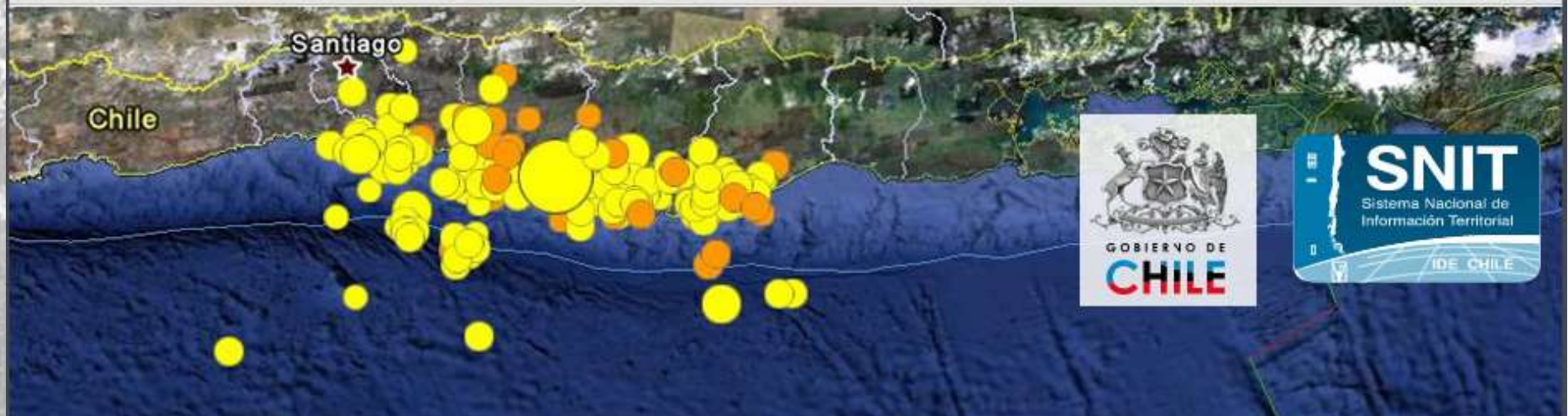
After the delineation of floodplains is performed overlapping areas between the area flooded by the Tsunami and the mapping of population and housing available to the INE. The process can establish a technical and theoretical estimates of population and dwellings affected by the tsunami. In this way 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).

[Inicio](#) [Sobre el sitio](#) [Enlaces](#) [Contáctenos](#)



# Multi-Sectoral Working Group Geospatial Information

## Description of institutional activities

### TYPES OF IMAGES USED

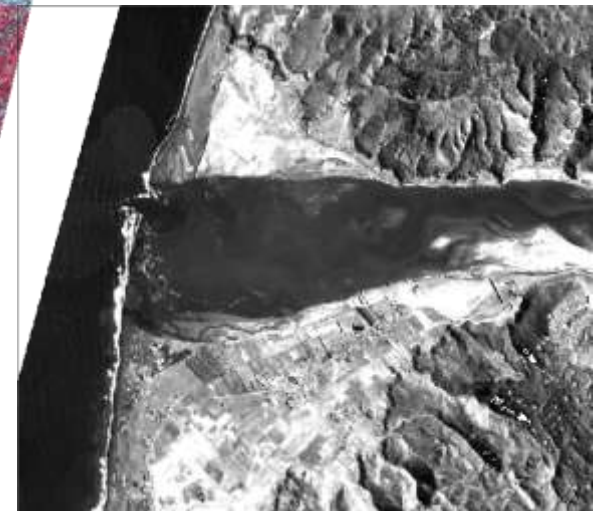
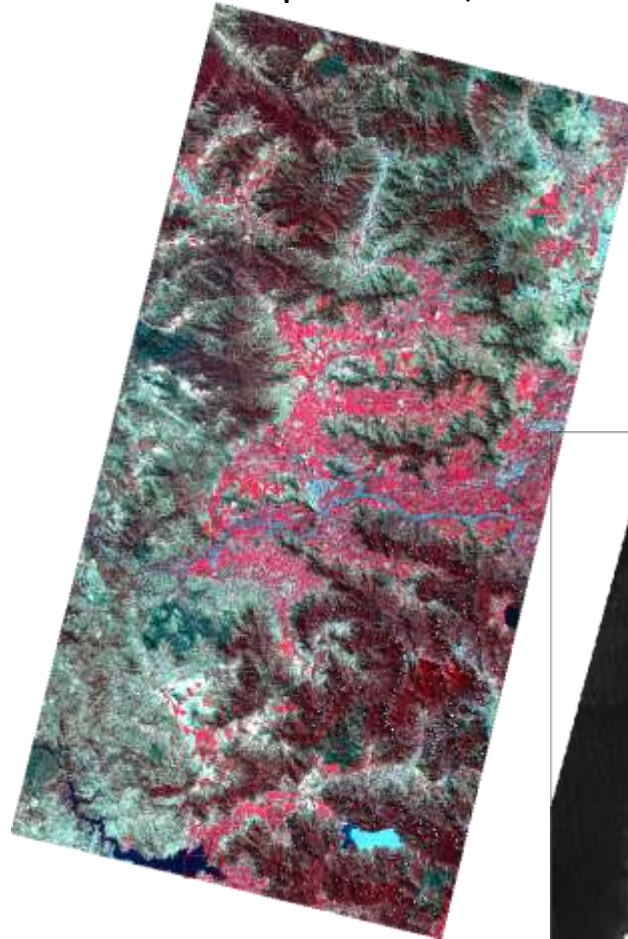
Aerial Photography: High Resolution Camera  
DMC.



Radar Image : SIASGE.  
Cosmo – SkyMed - SAOCOM



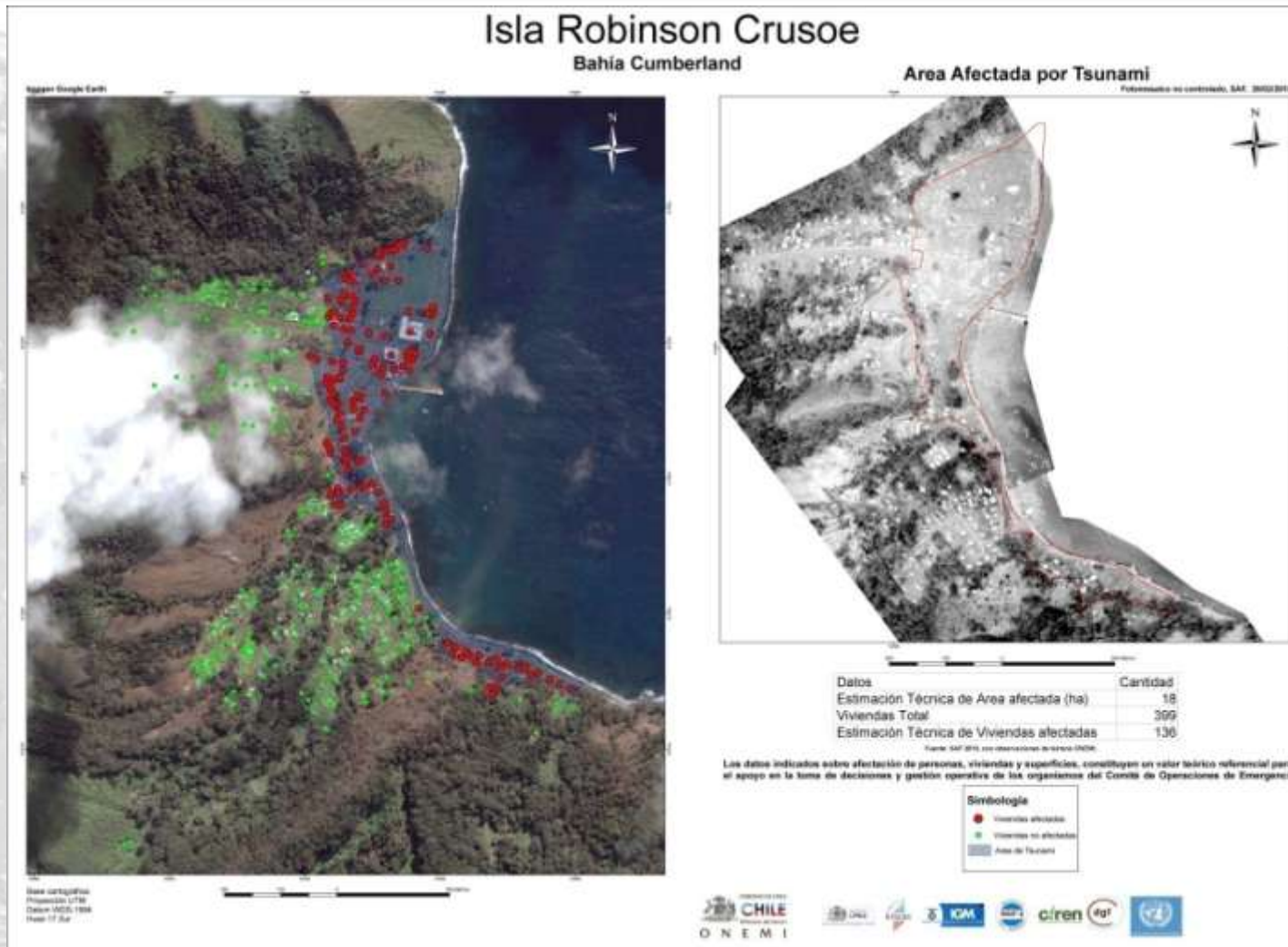
Optical Image: multiple sensors, the  
sample composition False color SPOT 5,  
Formosat panchromatic, etc.



# Multi-Sectoral Working Group

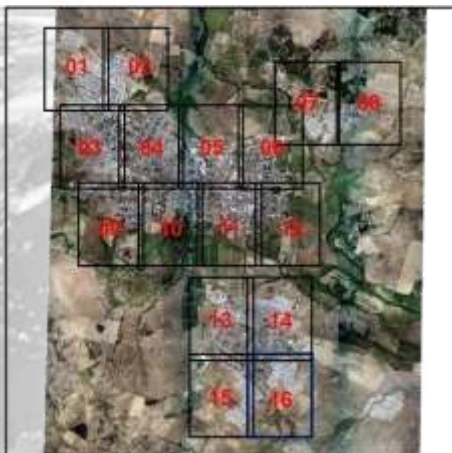
## Geospatial Information

### First thematic products



# Multi-Sectoral Working Group Geospatial Information First thematic products

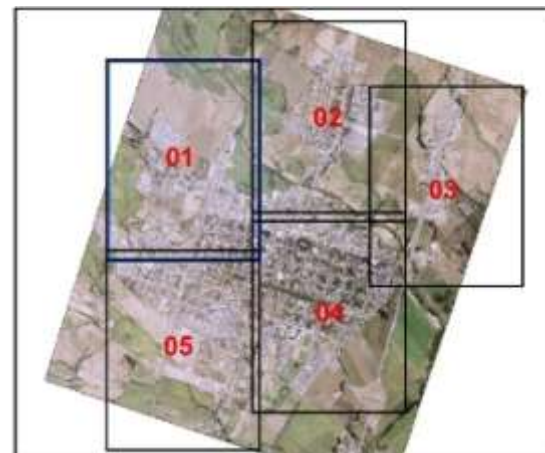
## Planimetry SAF



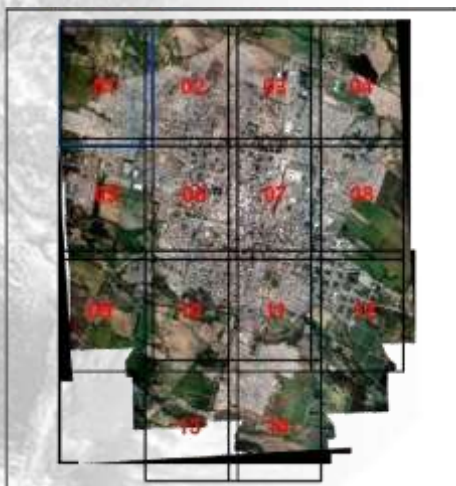
Cauquenes



Dichato



Parral



Linares



Concepción

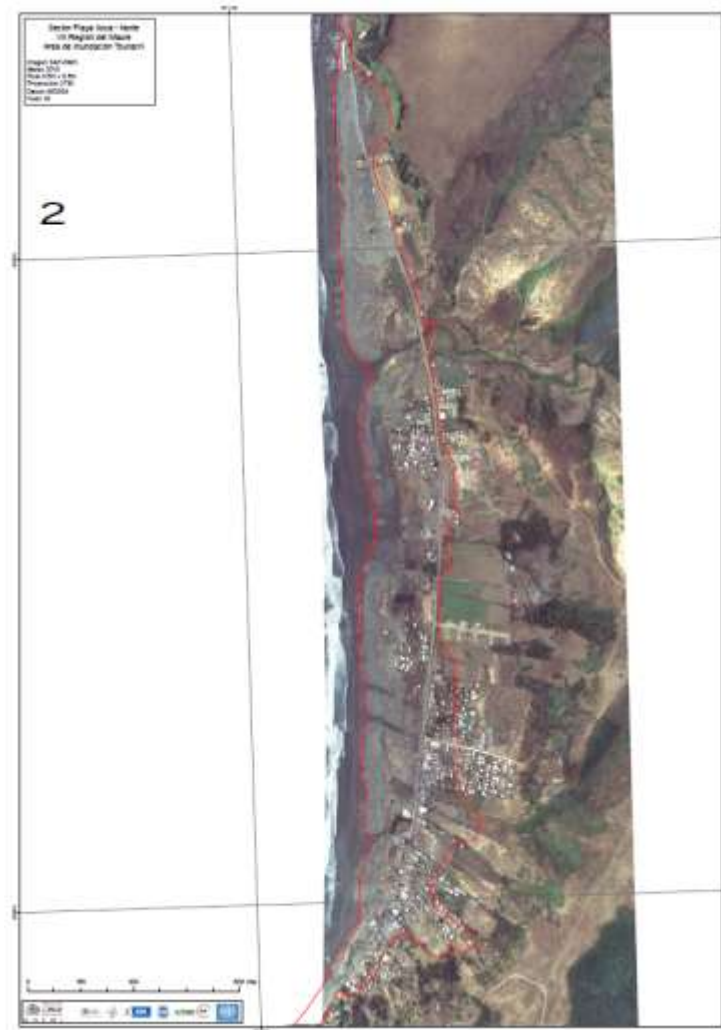
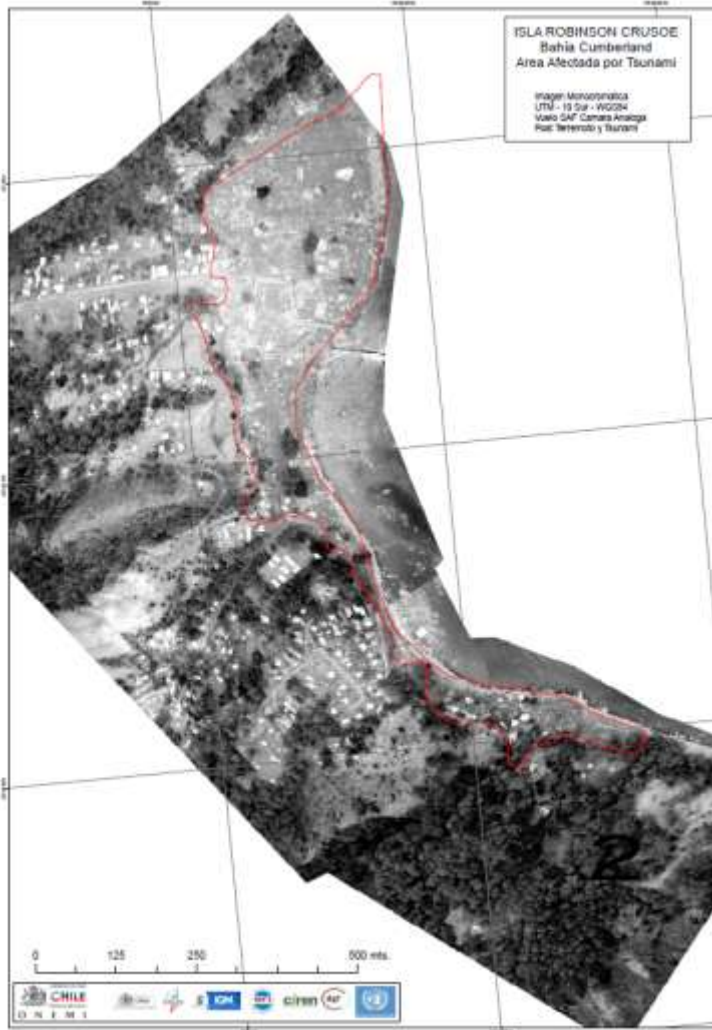


Tirúa



# First thematic products

## Flood Areas





# Constitución

## VII Región del Maule

### Area Afectada por Tsunami



Sensor RapidEye II - 27/02/2010

Datos	Cantidad	Porcentaje (%)
Area Constitución (km2)	7,73	100
Estimación Técnica Area afectada (km2)	2,43	34
Población Total (Proyectada al año 2010)	38.428	100
Estimación Técnica de la Población afectada (Proyectada al año 2010)	8.742	24
Viviendas Total	10.103	100
Estimación Técnica de Viviendas afectadas	2.669	30

Fuente: Censo 2002 - Marco Muestreo 2008

Los datos indicados sobre afectación de personas, viviendas y superficies, constituye un valor técnico referencial para el apoyo en la toma de decisiones y gestión operativa de los organismos del Comité de Operaciones de Emergencia



Base cartográfica:  
Proyección UTM  
Datum WGS-1984  
Huso 19

# Multi-Sectoral Working Group

## Geospatial Information

### First thematic products

# Multi-Sectoral Working Group Geospatial Information First thematic products

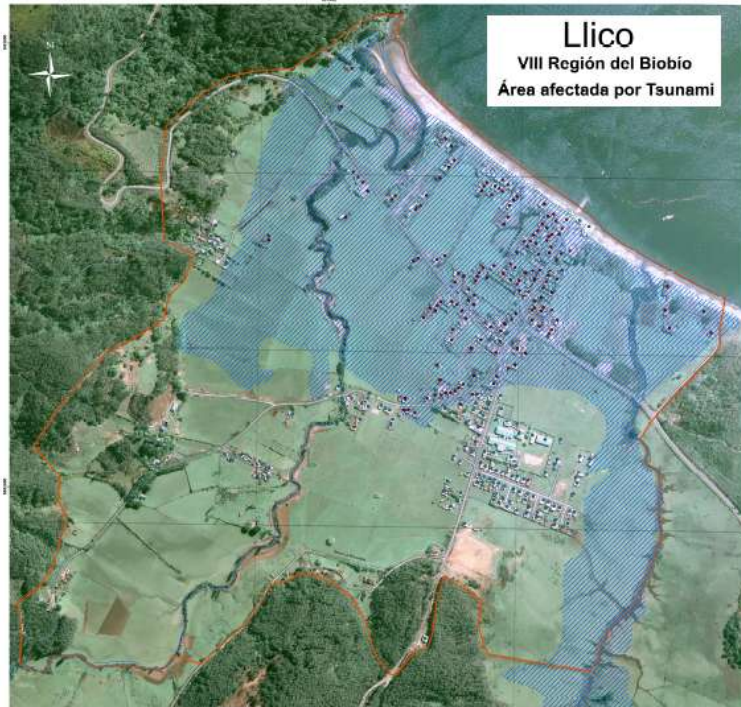


Imagen GoogleEye (Google Earth)  
Foto Octubre de 2006  
Pais: 128 x 100 metros  
UTM - 19 S  
Datum WGS84

0 75 100 300 450 600  
Metros

ES08 12250

Datos	Cantidad	Porcentaje (%)
Área Llico (Km <sup>2</sup> )	1,5	100
Estimación técnica de área afectada (Km <sup>2</sup> )	0,8	40,6
Población proyectada al 2010	792	-
Viviendas total (Censo 2002)	231	-
Construcciones afectadas por tsunamis*	157	-

\*: Fotointerpretación de construcciones, Imagen Google Earth

Los datos indicados sobre afectación de personas, viviendas y superficies, constituyen un valor técnico referencial para el apoyo en la toma de decisiones y gestión operativa de los organismos del Comité de Operaciones de Emergencia

#### Simbología

- Construcciones en área de inundación
- Construcciones
- Área Llico
- Área inundación tsunami



Fuente: Google Earth, 10 Diciembre 2009

Imagen GoogleEye (Google Earth)  
Foto Octubre de 2006  
Pais: 128 x 100 metros  
UTM - 19 S  
Datum WGS84

0 75 100 300 450 600  
Metros

Datos	Cantidad	Porcentaje (%)
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#### Simbología

- Construcciones en área de inundación
- Construcciones
- Área Llico
- Área inundación tsunami

# Multi-Sectoral Working Group Geospatial Information Future Proposals

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

## CIREN

Institution in charge of the  
digital processing of satellite  
information

## 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

## Multi-Sectoral Working Group Geospatial Information Future Proposals

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.

## Multi-Sectoral Working Group Geospatial Information Recommendation

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



GOBIERNO DE  
**CHILE**

and  
Chilean Space Agency

Fourth United Nations International  
UN-SPIDER Bonn Workshop on Disaster  
Management and Space Technology  
12 – 14 October 2010

# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

Edificio "D"

Destrucción de Autopista en Centro de Santiago, RM - Chile



Paseos de las caídas entrada de Santiago, RM - Chile



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

Iglesia de la Merced en Rancagua, VI Región - Chile

Iglesia La Compañía de Graneros, VI Región - Chile

Casas tradicionales destruidas en Rengo

Carretera de la Fruta, VI Región - Chile



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

Edificio Localidad de Pelluhue destruido por el tsunami, VII Región - Chile



Efectos del Tsunami en las costas de Centro de Concepción destruido, VIII Región - Chile

Zonas inundadas en Talcahuano, VIII Región - Chile



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

Centro de Temuco, IX Región - Chile

Calle de Temuco, IX Región - Chile



Hospital Regional, IX Región - Chile



**EFFECTOS 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

**DICHATO**



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010



**PELLUHUE**



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010



# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

**CONSTITUCIÓN**





# TALCAHUANO







Raúl Martínez Quiroz

# Grupo de Trabajo Multisectorial de Información Geoespacial Terremoto 2010

Edificio en Centro de Valparaíso



Farmacia destruida en centro de Viña del Mar, V Región, Chile



Edificio en Valparaíso, V Región, Chile



Hotel en Viña del Mar, V Región, Chile



Thank you very much



GOBIERNO DE  
**CHILE**

and  
Chilean Space Agency

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