How the scientific knowledge support the Chilean National Civil Protection System

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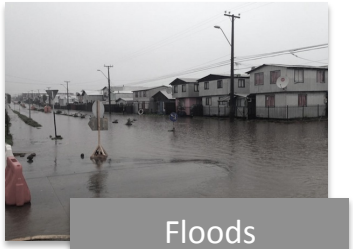
New Taipei City, July 31th, 2015

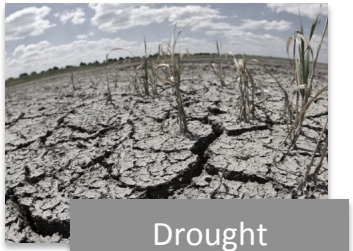
1 BACKGROUND AND HISTORY OF DISASTER RISK REDUCTION IN CHILE

CHILE: A COUNTRY OF NATURAL HAZARDS

Volcanic Eruptions



Floods



Drought

Earthquakes

Tsunamis

Landslides

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CHILE 2014 - 2015

2014 — A-B

2015 — C — D-E

A> APRIL 1ST.
PISAGUA EARTHQUAKE AND TSUNAMI:

Region of Tarapacá and Arica-Parinacota declared Zone of Catastrophe

6 casualties

1,200 USD MM$

900,000 people evacuated after a tsunami alert

B> APRIL 12TH.
GREAT FIRE OF VALPARAISO:

Commune of Valparaiso and Viña del Mar declared Zone of Catastrophe

15 casualties

10,292 people affected and 2,975 damaged homes

C> MARCH 25TH.
FLASH FLOODS IN THE NORTH OF CHILE:

Region of Atacama declared Zone of Catastrophe

31 confirmed dead as of May 4th, 2015

86 missing persons

246 people in shelters

500 MM$ USD earmarked for reconstruction

D> APRIL 22ND.
VOLCÁN CALBUCO ERUPTION:

Province of Llanquihue and Osorno declared Zone of Catastrophe

Sanitary alert also issued

Nearly 6,600 people evacuated

4 communes declared under agricultural emergency

50 USD MM$ estimated economic losses

E> MARCH 3RD.
VOLCÁN VILLARRICA ERUPTION:

Over 5,000 people evacuated

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A HISTORY OF DISASTERS AND MEASURES

1906
- The National Seismological Service is founded on the 1st of May, in response to the 1906 Valparaiso earthquake.

1960
- The Mw9.5 Valdivia earthquake, the largest earthquake in recorded history, strikes in the south of Chile, along the outskirts of Lumaco, causing widespread damage.

1966
- The first anti-seismic law is established in Chile.

1966
- The Ministry of National Defense creates the Hydrographic Institute, the official representative of Chile in the International Pacific Tsunami Warning System, while also establishing the first National Tsunami Warning System in Chile.

1974
- The National Emergency Office under the Interior Minister is created, representing the first national effort to establish a coordinating entity for disaster response and recovery.

A HISTORY OF DISASTERS AND MEASURES

1985
- The first anti-seismic law is updated to accommodate for new building conditions and anti-seismic requirements.

2002
- The conceptual and methodological framework for risk management in Chile is established through Supreme Decree Nº 156.

2010
- The Mw8.8 February 27 earthquake, strikes near Constitución in the Bíobío region, creating catastrophic consequences for nearby cities and the whole southern region, also causing serious damage to other neighboring regions and the Juan Fernandez Archipelago.

2012
- The National Research Center for Integrated Natural Disaster Management, CIGIDEN, is inaugurated.

2014
- President Bachelet signs the legal indication that establishes the National Emergency and Civil Protection System and creates the National Agency of Civil Protection, which is to replace the current National Emergency Office.

2 SCIENTIFIC SUPPORT

CHILEAN SISMOLOGICAL SERVICE

MISSION:

To provide timely information on the occurrence of earthquakes in the country and determine its main parameters.

SYSTEMS:

National network of accelerographs (RENADIC)

CSN
CENTRO SISMOLÓGICO NACIONAL
UNIVERSIDAD DE CHILE

SHOA

CHILEAN NAVY HIDROGRAPHIC AND OCEANOGRAPHIC SERVICE

MISSION:
Provide technical elements, information and technical assistance to offer navigation safety in the Chilean littoral.

SYSTEMS:

- Tsunami Risk Evaluation through seismic Moment from a Real time System.
- Deep ocean Assessment and reporting of Tsunamis
- Emergency Manager Warning Information Network

SNAM Chile

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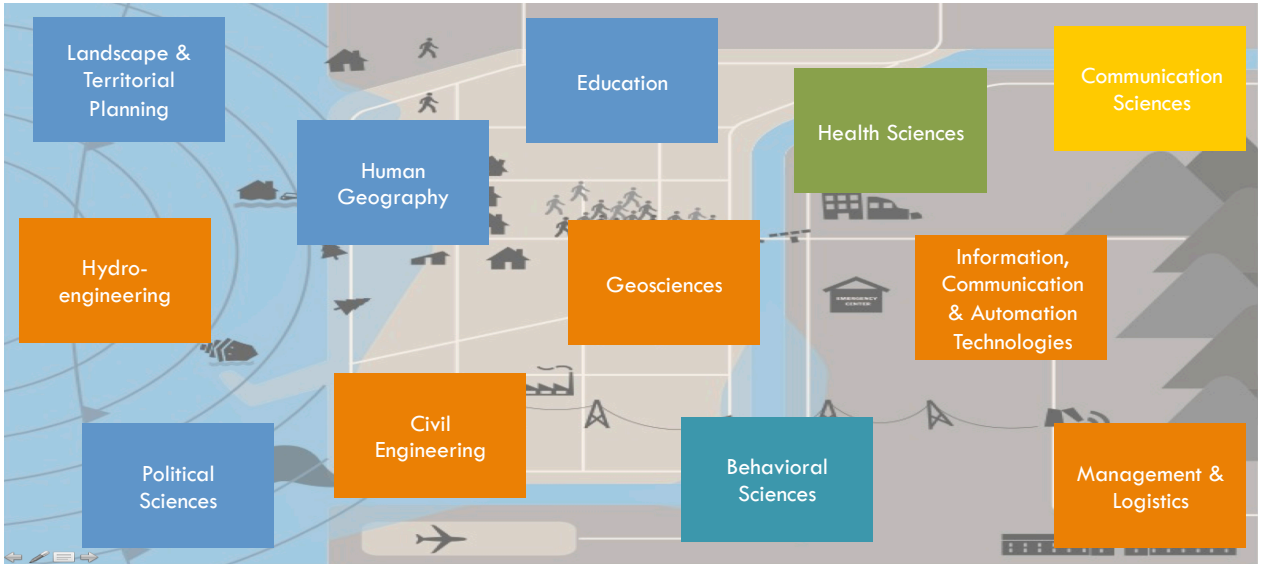
NATIONAL RESEARCH CENTER FOR INTEGRATED NATURAL DISASTER MANAGEMENT



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3 WHO WE ARE

MISSION

CIGIDEN

CIGIDEN is an interdisciplinary research effort whose primary goal is to contribute towards minimizing the social consequences of natural disasters, by developing, integrating, and disseminating scientific, technological, and social knowledge, while simultaneously developing the scientific and technical capacities required to strengthen and position Chile as a world research leader in natural disaster research

RESEARCH LINES

SOLID EARTH PROCESSES AND ASSOCIATED HAZARDS

Gabriel González (UCN)

Structural Geology, Geotectonics, Upper Faults, Seismology

SURFACE WATER PROCESSES AND ASSOCIATED HAZARDS

Rodrigo Cienfuegos – Director (UC)

Coastal Processes, Tsunami Research, Floods and Landslides

VULNERABILITY AND RISK ANALYSIS OF PHYSICAL AND SOCIAL SYSTEMS

Juan Carlos De la Llera (UC)

Seismic Engineering, Vulnerability of Engineered Systems, Risk Analysis, Seismic Isolation

EMERGENCY RESPONSE AND MANAGEMENT

Paula Repetto (UC)

Mental Health and Psycho-Social Determinants for Resiliency, Protocols and Training for First Responders, Humanitarian Logistics, Evacuation

SUTAINABLE RISK MITIGATION

Roberto Moris (UC)

Urban Planning, Risk Perception, Education, Decision Making Analysis for Recovery and Sustainable Reconstruction

INFORMATION, COMMUNICATION, AND AUTOMATION TECHNOLOGIES FOR DISASTER MANAGEMENT

Aldo Cipriano – Deputy Director (UC)

Early Response Systems and Decision Support Systems, Remote Sensing and Wireless Sensor Networks, Social Networks and Mass Media Communication in Emergency Situations

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CIGIDEN BY NUMBERS

Researchers

- 6 Principal researchers
- 25 Asocciate researchers
- 23 Other researchers
- 7 Adjunct researchers

Formation of Advanced Human Capital

- 9 Postdoctoral researchers
- 47 Undergraduate students
- 57 MSc students
- 24 PhD students

Publications

- 53 Publications
- 16 Publications in collaboration with international researchers
- 1 Book
- 4 Book chapters

INTERNATIONAL NETWORKS

Researchers Exchange Programs

Shared Graduate Degree Programs

Summer Institutes for Graduate Students

CURRENT RELEVANT COOPERATION ACTIONS

- **Seed funding for research cooperation with MIT, UND, Texas A&M**
- **Chilean representative in GEM**
- **Participation in the Global Seismic Network with GFZ**
- **Research project on tsunami mitigation with Japanese institutions (SATREPS)**

EUROPE

- German Research Center for Geoscience (GFZ)
- Freie Universität Berlin
- Geoforschungszentrum
- Technische Universität Darmstadt
- DLR (Germany)
- TU Delft (The Netherlands)
- Université de Grenoble (France)
- Université de Bordeaux (France)
- IRD (France)
- Global Earthquake Model (GEM)

NORTH AMERICA

- University of Notre Dame
- Delaware University - DRC
- Cornell University
- Johns Hopkins University
- US Geological Survey
- California Polytechnic State University
- Columbia University
- FEMA

SOUTH AMERICA

- Universidad de San Luis (Argentina)
- Universidad Nacional de Ingeniería (Perú)
- CISMID (Perú)

ASIA PACIFC

- Japan International Cooperation Agency
- Port and Airport Research Institute Through SATREPS project
- Meteorological Research Institute
- Japan Agency for Marine-Earth Science and Technology
- Kansai University
- Tohoku University
- Tokyo University

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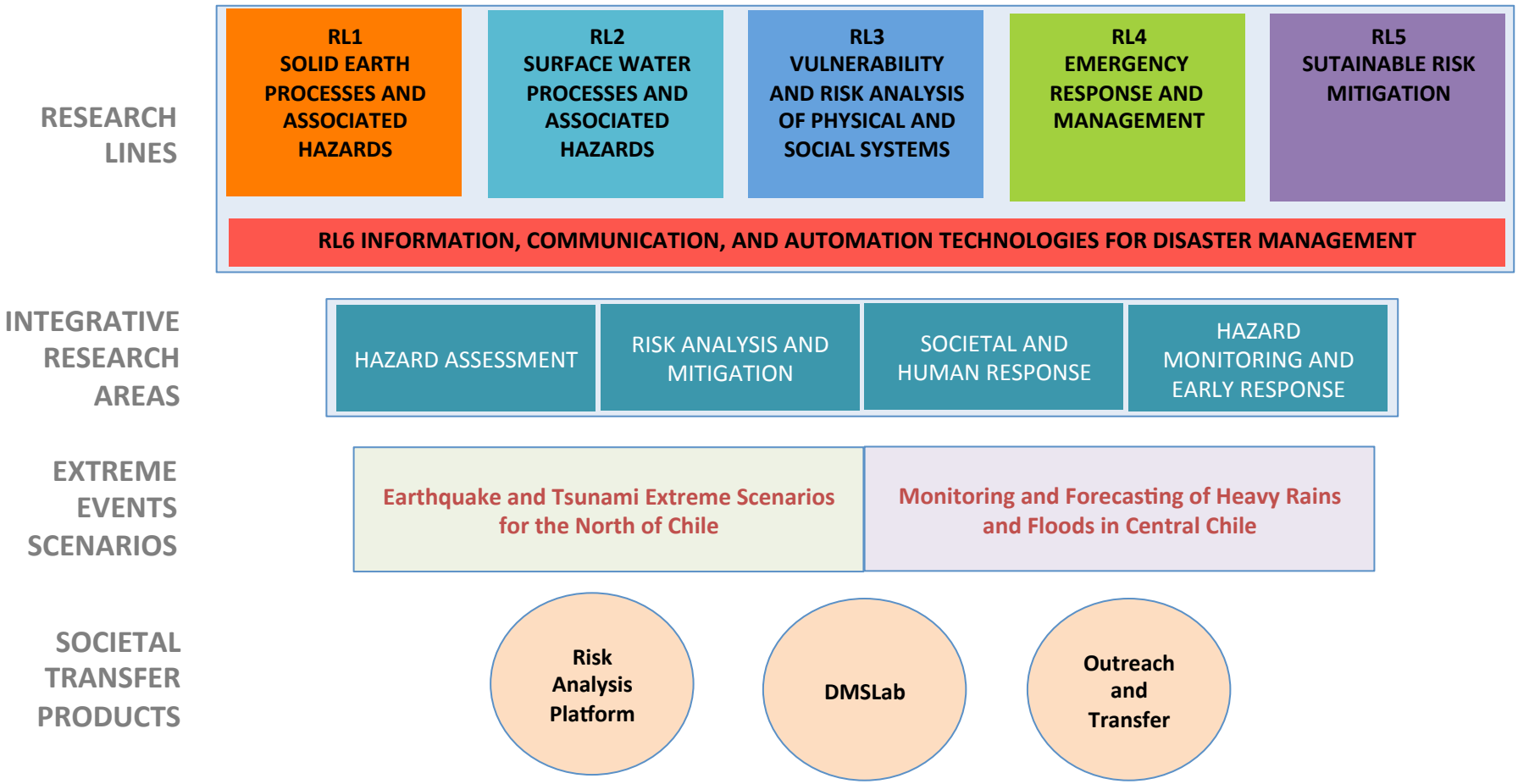
FRAMEWORK FOR RESEARCH



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3 RESEARCH AREAS AND SCIENTIFIC OBJECTIVES

HAZARD ASSESSMENT

SCIENTIFIC OBJECTIVES

1. To determine potential seismic and tsunamigenic scenarios for the north of Chile post Pisagua 2014 Earthquake (RL1-RL3)
2. To develop and validate micro zonation techniques for seismic hazard mapping with limited field data availability (RL1-RL3)
3. To develop, validate, and quantify uncertainty (epistemic and aleatoric) when applying high resolution tsunami propagation and inundation models for hazard mapping (RL2-RL1)
4. To develop and validate high resolution hydrological-hydraulic models to forecast and propagate flash floods in pre-andean watersheds in Central Chile (RL2-RL6)

PRINCIPAL CONTRIBUTIONS

1. Seismic hazard maps including the most relevant variables for risk and mitigation analysis are provided for the three most important cities in northern Chile
2. High resolution tsunami inundation maps including the most relevant variables for hazard, risk, and mitigation analysis are provided for the three most important cities in northern Chile
3. A nearly real-time hydrometeorological forecasting model is developed for flash floods alerting in Central Chile

RISK ANALYSIS AND MITIGATION

SCIENTIFIC OBJECTIVES

1. To develop and implement an integrated theoretical and computational framework capable of coupling the seismic/tsunami risk analysis, and other consequential hazards, with human and societal response.
2. To study the vulnerabilities and fragilities of the Chilean building stock, infrastructure, lifelines, and human stock subjected to extreme loading conditions.
3. To develop and implement ABMs to simulate evacuation processes and integrate the response of the physical stock with knowledge of agents derived from cognitive psychology.
4. To investigate societal performance at different scales during earthquakes and tsunamis and evaluate possible mitigation measures.

PRINCIPAL CONTRIBUTIONS

1. A computational engine and platform is implemented to study seismic and tsunamigenic Extreme Event Scenarios and their consequences in the pilot city
2. Perform a comprehensive seismic and tsunamigenic risk evaluation in a pilot city.
3. A set of mitigation strategies are evaluated using Hazus and ABM (evacuation protocols) and transferred to the community

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SOCIETAL AND HUMAN RESPONSE

SCIENTIFIC OBJECTIVES

1. To characterize factors that determine individual and community preparedness and resiliency.
2. To understand protocols for emergency response in pre and post disaster scenarios.
3. To understand tsunami evacuation behavior to improve evacuation planning, communication protocols, warning and signs standards, education, and the dissemination of information.
4. To understand public risk perceptions, trust, preparedness, and risk acceptability.
5. To characterize and understand the information dissemination protocols from mainstream media.
6. To develop suitable IT architecture to gather and analyze messages from social networks to support the decision-making process.

PRINCIPAL CONTRIBUTIONS

1. Implement a humanitarian response simulation model in a pilot city.
2. A vulnerability/resiliency index is proposed to take into account additional individual and social dimensions
3. Disaster response communication protocols and warning and sign standards
4. A model for mainstream media to inform citizens during the response phase of a disaster.
5. Mobile applications that can be used by the citizens to "listen" to the "natural disaster" channel

HAZARD MONITORING AND EARLY RESPONSE

SCIENTIFIC OBJECTIVES

1. To evaluate monitoring and forecasting options for tsunami detection and alerting.
2. To develop a Fast Flash Flood Early Warning System (FFEWS) in ungauged basins based on a WSN, multi-sensor data interpretation, and hydrometeorological models.
3. Real Time Early Response System architecture based on the automatic control of environmental cues for guiding individuals during evacuation.

PRINCIPAL CONTRIBUTIONS

1. Tsunami detection options are evaluated in view of enhancing evacuation and minimizing casualties
2. Propose a nearly Real-Time Decision Support System architecture for Early Response Disaster Management to improve evacuation processes from public places.
3. The development and testing of a prototype of FFEWS is as a proof-of-concept in the Quebrada de Ramón.

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MUCHAS GRACIAS

谢谢

ありがとう

Terima kasih

THANK YOU

cam on

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