NATIONAL RESEARCH CENTER FOR INTEGRATED DISASTER RISK MANAGEMENT

CIGIDEN

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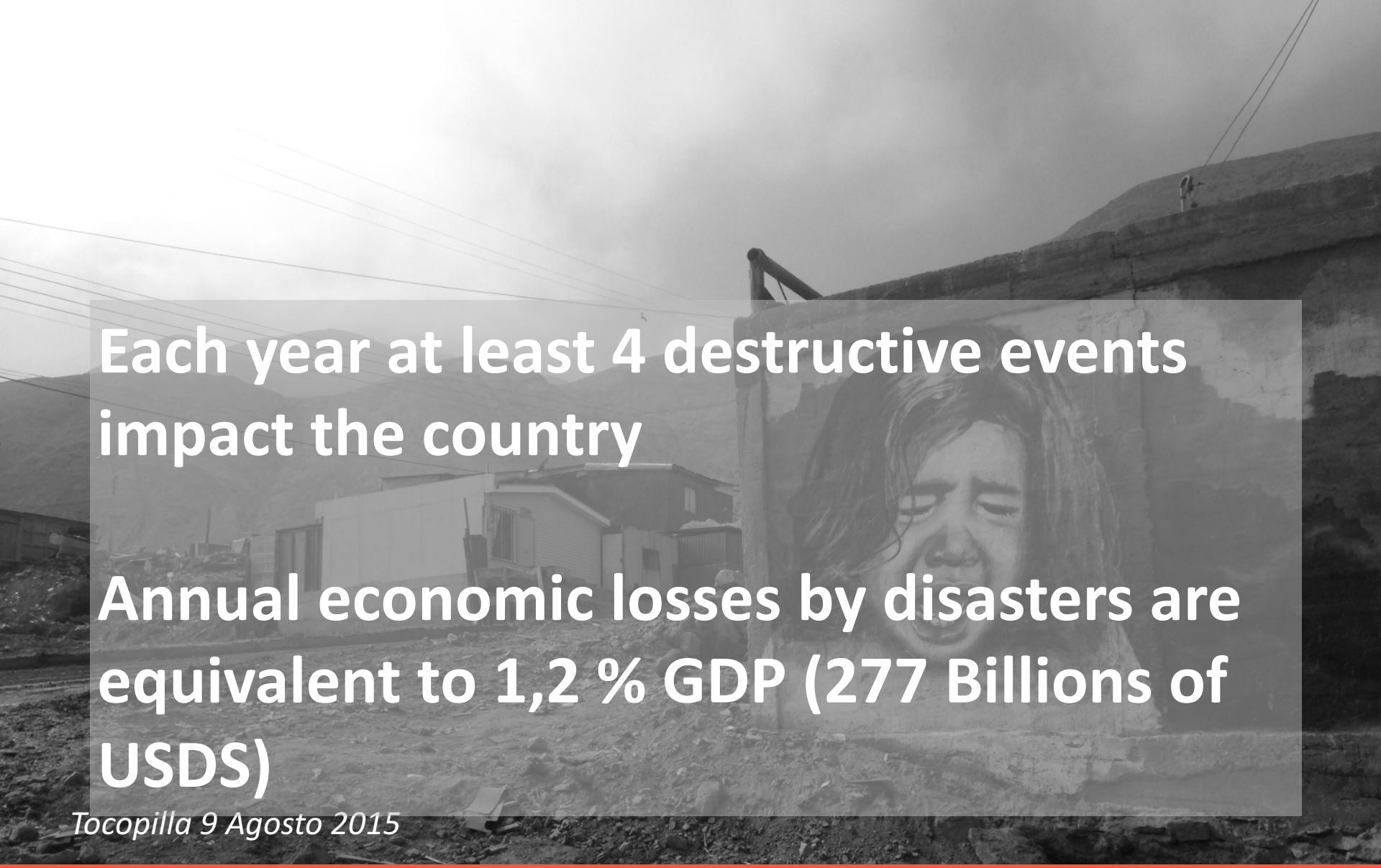
www.cigiden.cl

CIGIDEN
Centro de Investigación para la Gestión Integrada de Riesgos de Desastres

CONICYT Ministerio de Educación
Gobierno de Chile

EX UMBRA IN SOLEM



Each year at least 4 destructive events impact the country

Annual economic losses by disasters are equivalent to 1,2 % GDP (277 Billions of USDS)

Tocopilla 9 Agosto 2015

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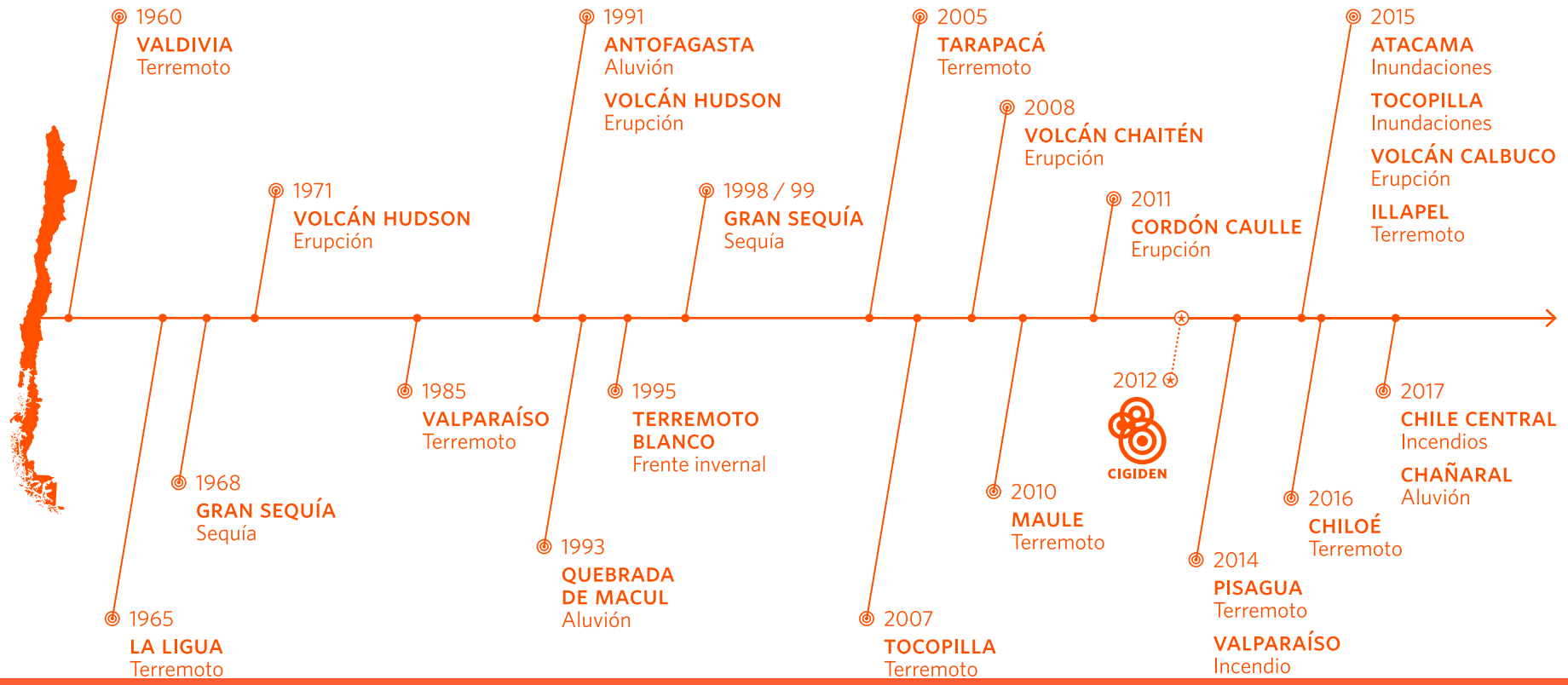
CHILE IS VERY EXPOSED TO NATURAL EVENTS

59 years of Natural Events Record

- 8 destructive earthquakes (Mw 7.7-9.4)
- 4 Great volcanic eruptions
- 5 Massive floods
- 3 High impact Forest fires



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CHILE IS VERY EXPOSED TO NATURAL EVENTS

CONICYT/FONDAP Call for Proposals in 2011. CIGIDEN BIRTH

Facts

- Massive systemic failure caused by the 2010 Earthquake/tsunami. Alert Failure, Crisis Response, People behavior, large number of victims (530) and 30 billion of dollars in losses

Right after the 2010 Maule Earthquake

CONICYT asked for creating:

- An Excellence Research Centers **in Disaster Risk Reduction.**
- Scientific basis to contribute in the **definition of EWS**, efficient **mitigation strategies**, and **emergency response**
- Research aimed to understand and improve **social resiliency**
- Coordination with national institutions and collaboration with international research institutions

1 CIGIDEN, 2011-2016

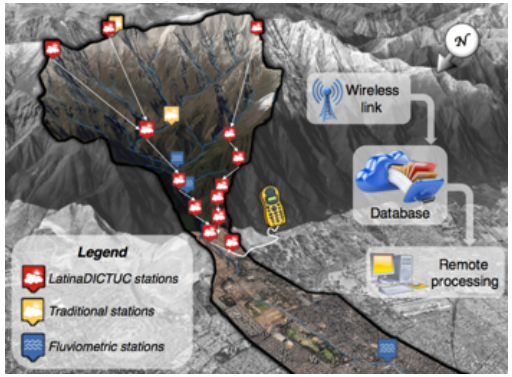
MAIN OUTCOMES WITH NATIONAL IMPACTS

A NEW TSUNAMI EWS

Operating by SHOA

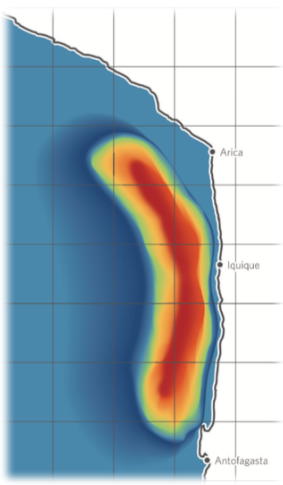
FLOODING EWS

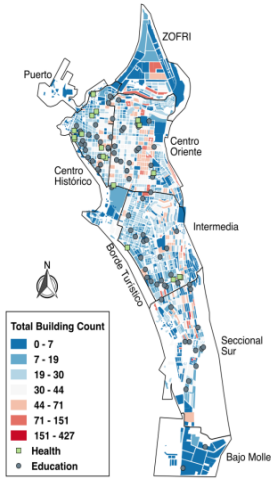
Prototip

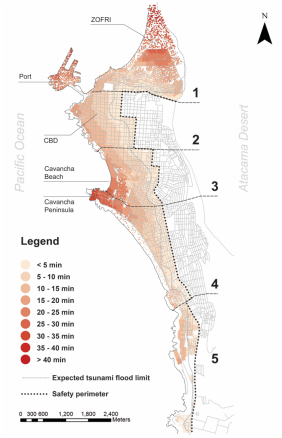


EARTHQUAKE SCENARIOS, EVACUATION AND RISK MODELS

Research







PRESIDENCIAL TASK FORCE

Srategy definition for science-technology in DRD

CIGIDEN 2017-2022

THE SIZE OF CIGIDEN

PEOPLE

8 Principal researchers.

16 Associated researchers.

26 Invited researchers.

14 postdocs.

12 Professionals.

3 Administrative personals.

INDICATORS

Indicator	2018
Article WoS	62
Impact factor	2,6
Number of article in Top 10	11

CIGIDEN RESEARCH

NATURAL SYSTEMS AND PROCESSES

L1
Solid earth processes and associated hazards

- Spatio-temporal processes in earthquake phenomena.

L2
Surface water processes and associated hazards

- Coastal processes and hazards.
- Hydroclimatic hazards in a context of global change.

SOCIAL PRACTICES

L4
Disaster cultures and risk governance

- Disaster cultures and risk.
- Disaster behavioral health.

L6
Information, communication and technologies for disaster risk management

- Mediated communication and emerging technologies.

RISK AND RESILIENCE ANALYSIS

L3
Risk and resilience of complex systems and networks

- Risk and resilience of complex networks.
- Present and future disaster risks in urban settings.

L5
Socio-economic assessment of disasters an mitigation strategies for resilient critical infrastructure systems

- Socioeconomic assessment of disaster consequences.

OUTREACH TO SOCIETY

Institutional improvements · Citizen engagement in disaster risk reduction processes · Risk and resilience research platforms

MAIN RESEARCHERS

2017-2022

SOCIAL PRACTICES

RL4 DISASTER CULTURES AND RISK GOVERNANCE

Manuel Tironi
Sociology & Anthropology

Paula Repetto
Disaster Behavioral Health

RL6 COMMUNICATION, AND EMERGING TECHNOLOGIES FOR DISASTER RISK REDUCTION

Gonzalo Bacigalupe
Psychology & Public Health

NATURAL SYSTEMS AND PROCESSES

RL1 SOLID EARTH PROCESSES AND ASSOCIATED HAZARDS

Gabriel González – Deputy Director
Earth Science & Natural Hazards

RL2 SURFACE WATER PROCESSES AND ASSOCIATED HAZARDS

Rodrigo Cienfuegos – Director
Earth Sciences & Civil Engineering

RISK AND RESILIENCE ANALYSIS

RL3 RISK AND RESILIENCE OF COMPLEX SYSTEMS AND NETWORKS

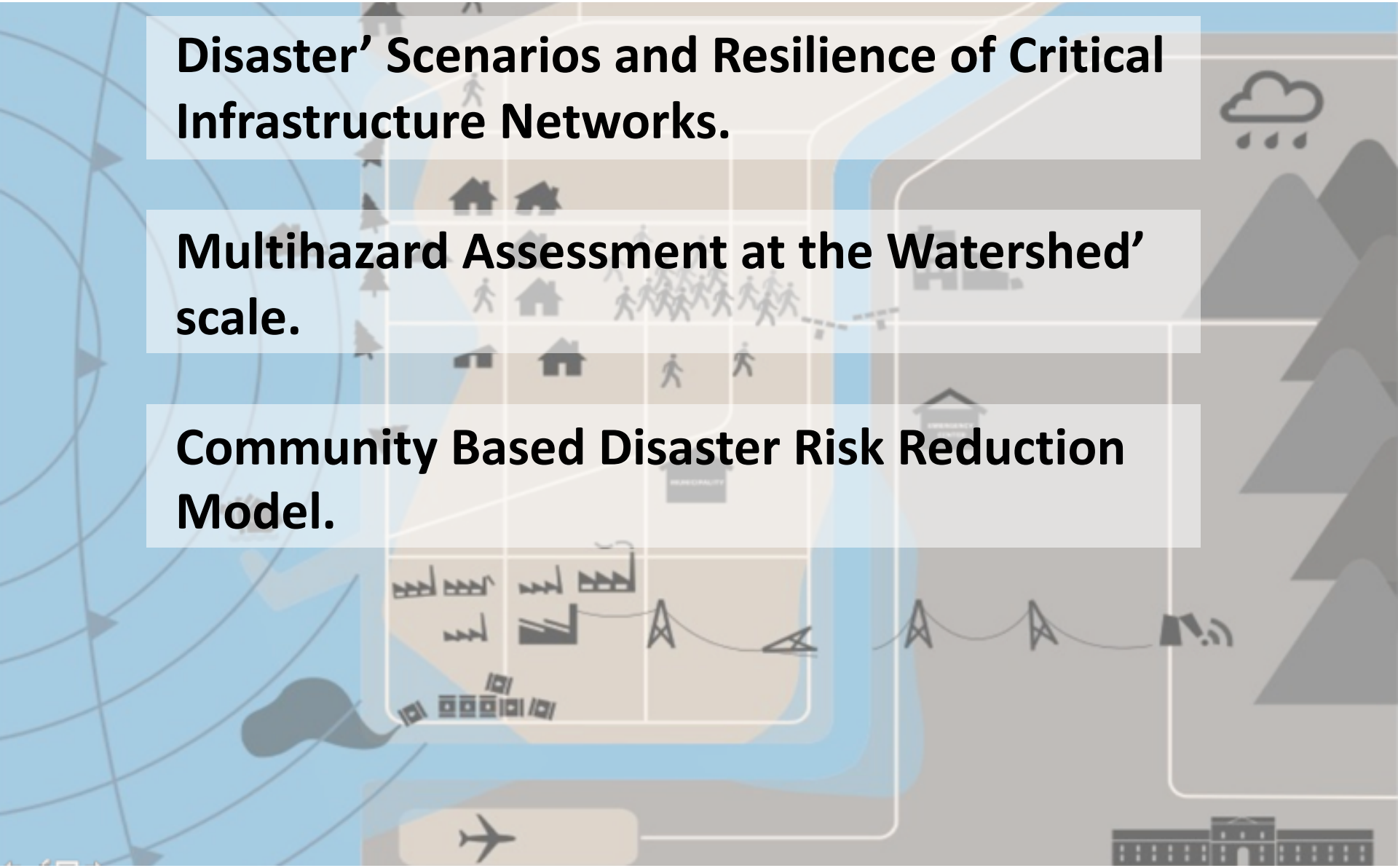
Juan Carlos De la Llera
Civil Engineering/Risk Resilience of Physical Systems

RL5 SOCIO-ECONOMIC OF DISASTERS AND MITIGATION STRATEGIES FOR RESILIENT CRITICAL INFRAESTRUCTURE SYSTEMS

Nicolás Bronfman
Risk Perception and Socio-Economic Assessment

Alondra Chamorro
Civil Engineering & Infrastructure Management

OUR STUDY IS FOCUSSED IN CENTRAL CHILE

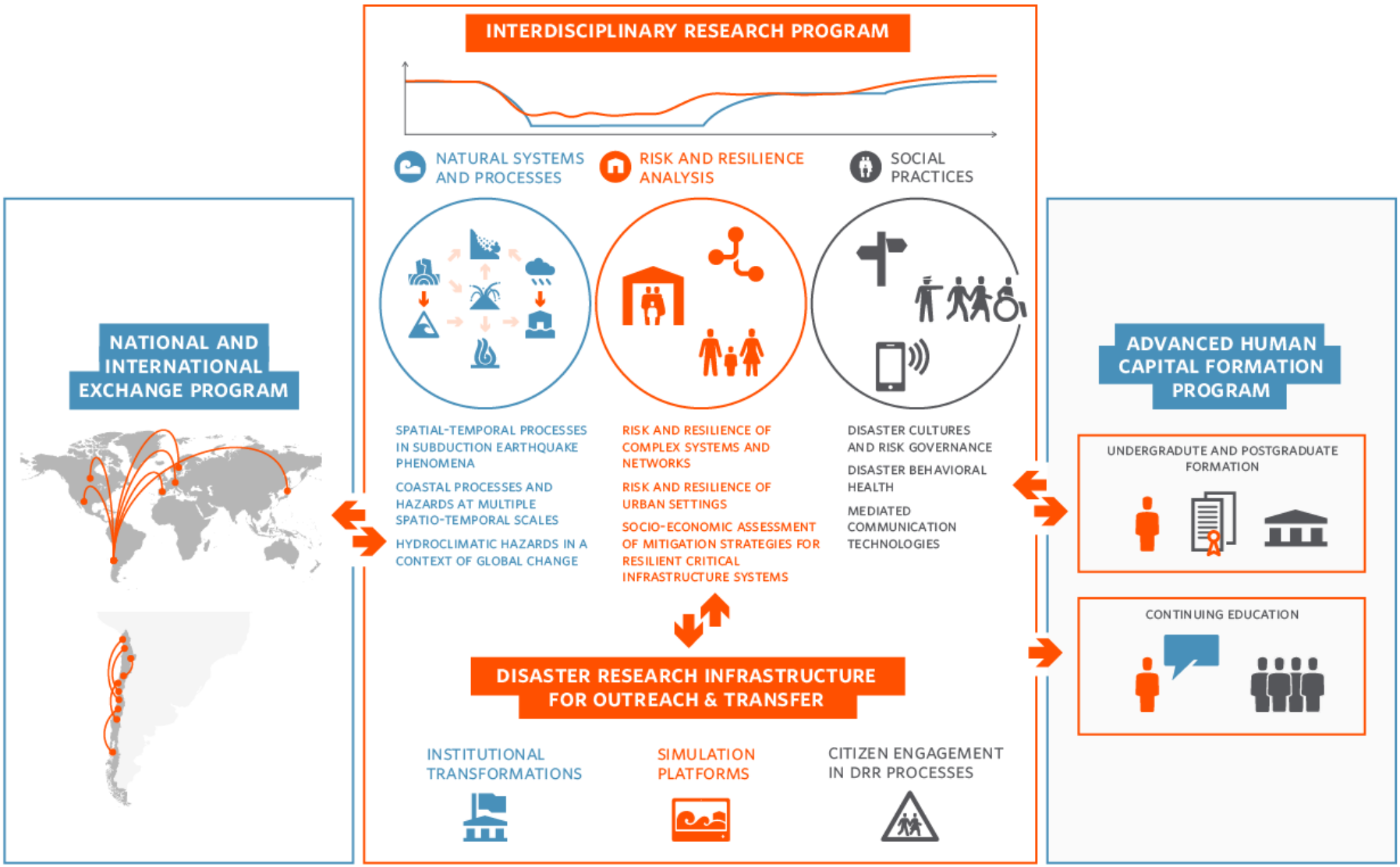


Disaster' Scenarios and Resilience of Critical Infrastructure Networks.

Multihazard Assessment at the Watershed' scale.

Community Based Disaster Risk Reduction Model.

STRATEGIC PROGRAMS 2017-2022



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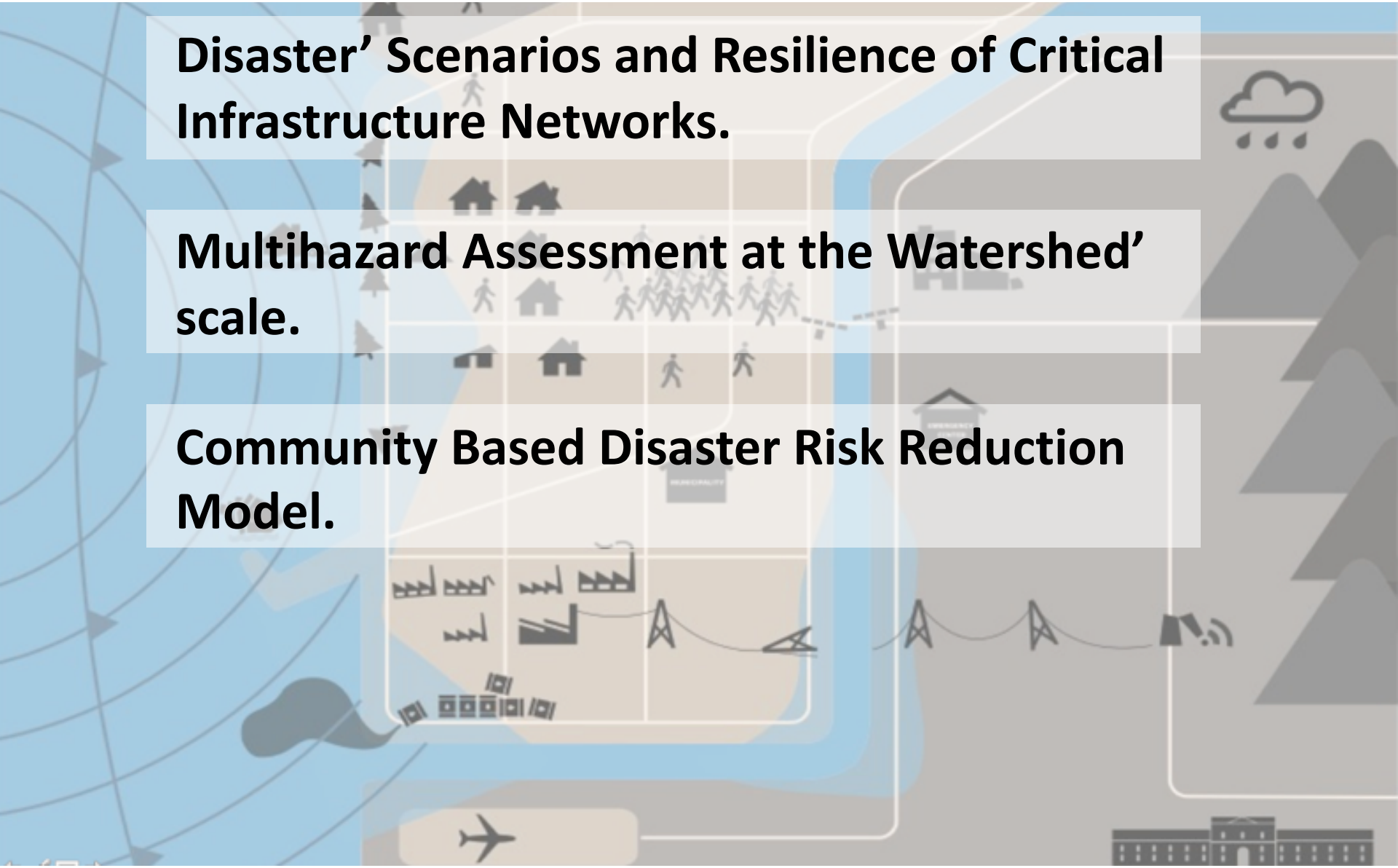
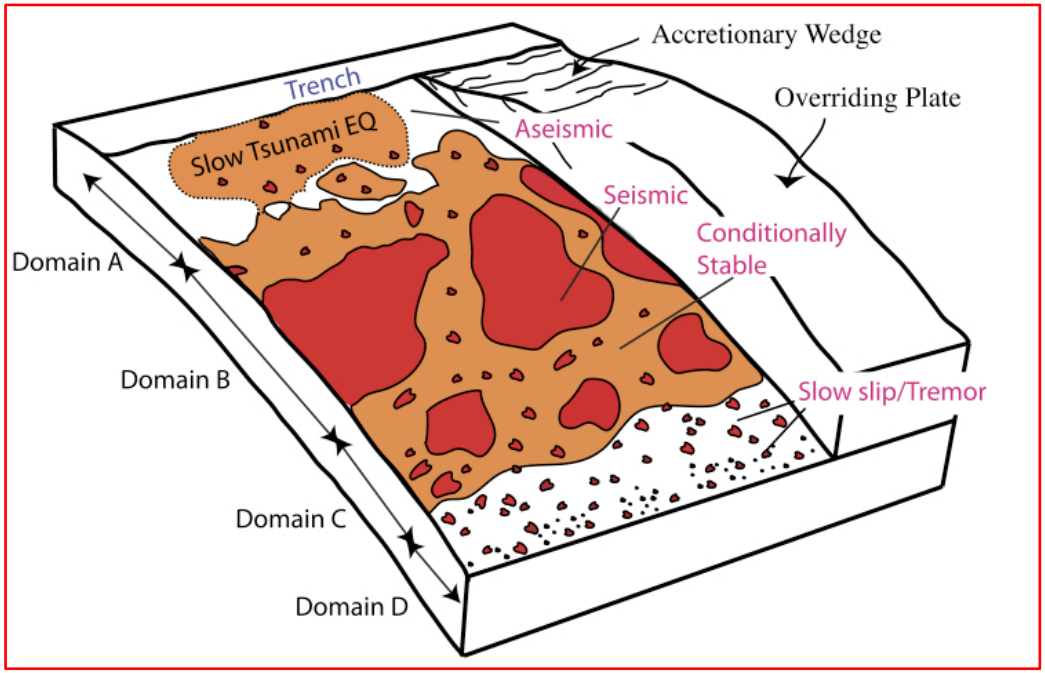


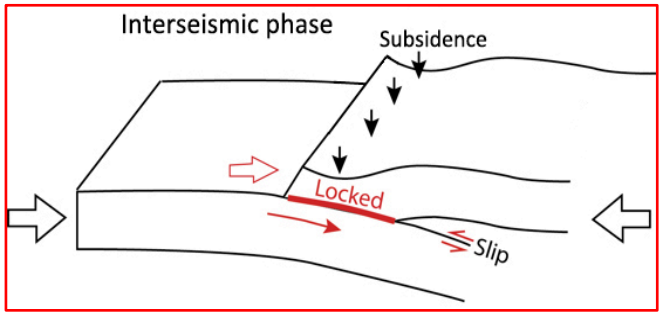
Disaster' Scenarios and Resilience of Critical Infrastructure Networks.

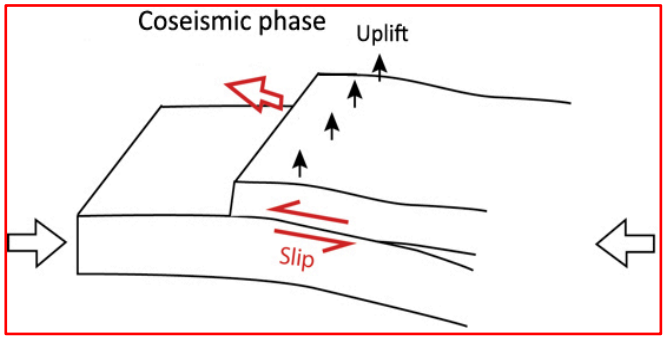
Multihazard Assessment at the Watershed' scale.

Community Based Disaster Risk Reduction Model.

Earthquake generation, coseismic and postseismic slip and mechanical propiertes of the plate interface



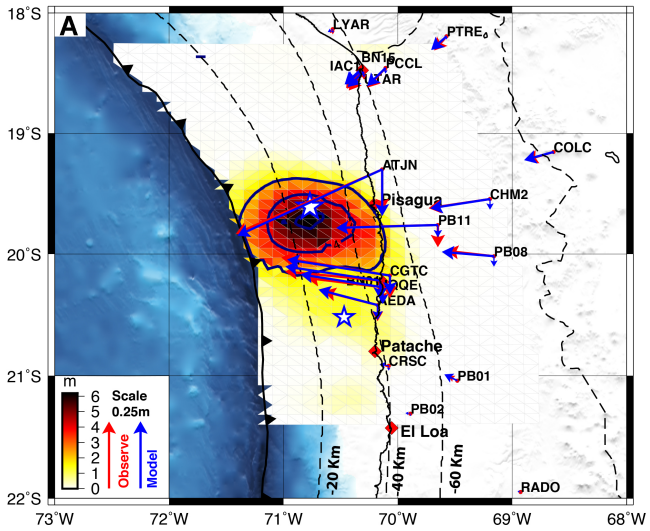


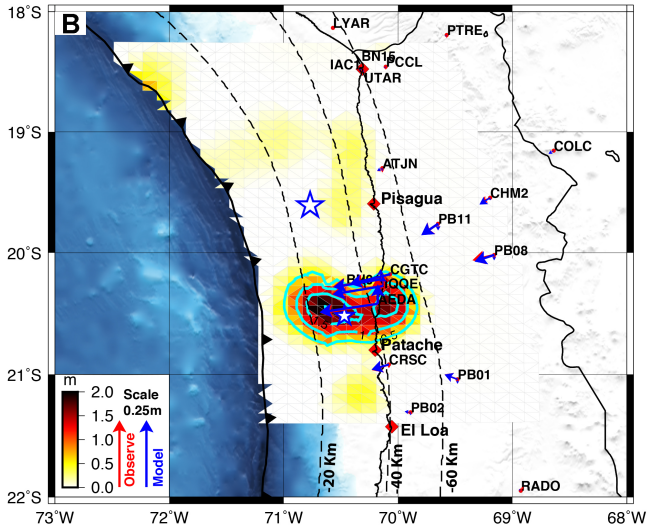


Lay, (2015)

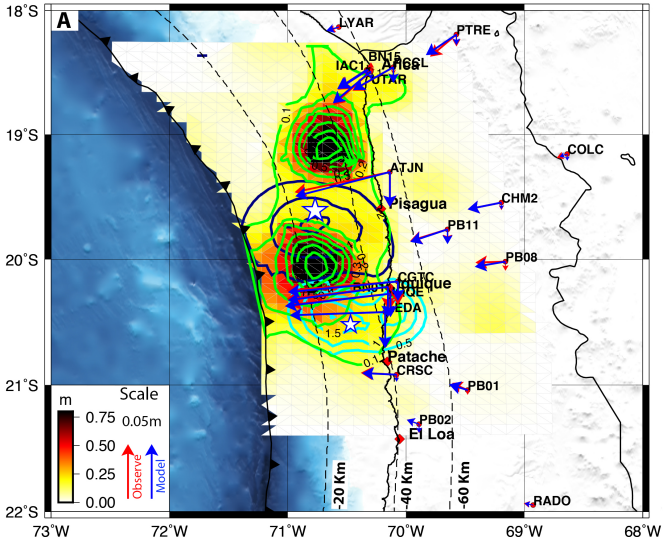
2014 Mw 8.2 PISAGUA EARTHQUAKE

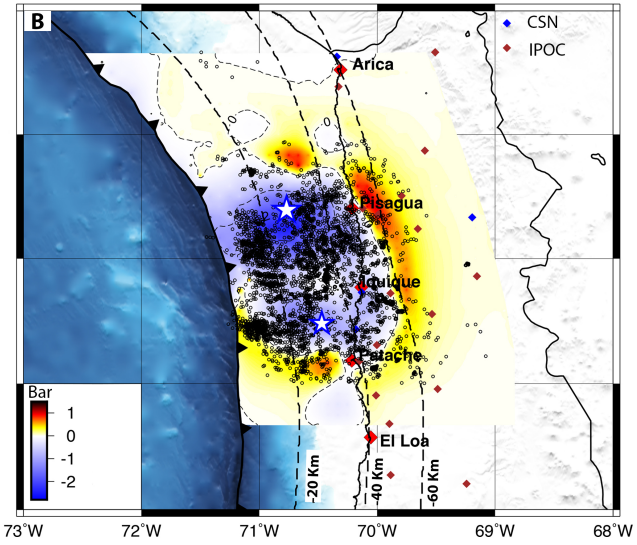
Coseismic





2 years of postseismic

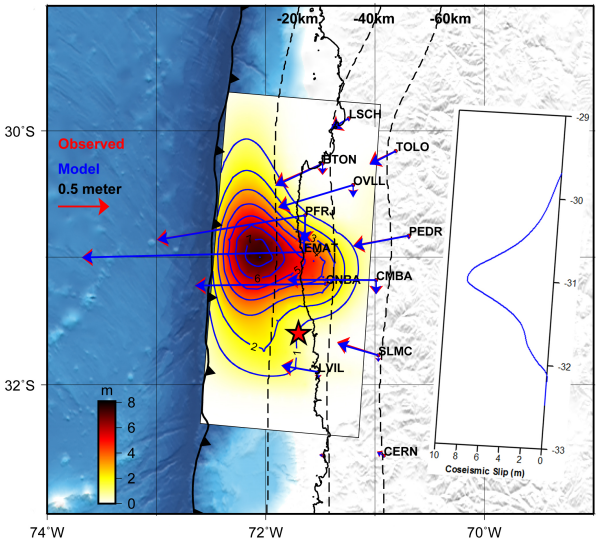




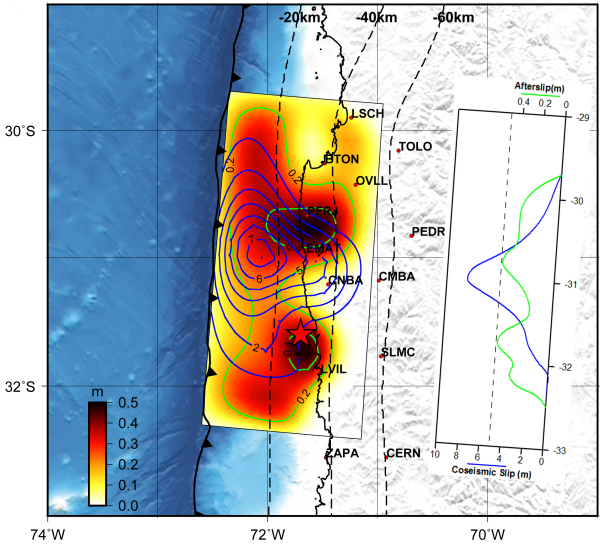
Mahesh Shrivastava, Gabriel González, et al. (2019). (*Scientific reports*)

2015 Mw 8.3 ILLAPEL EARTHQUAKE

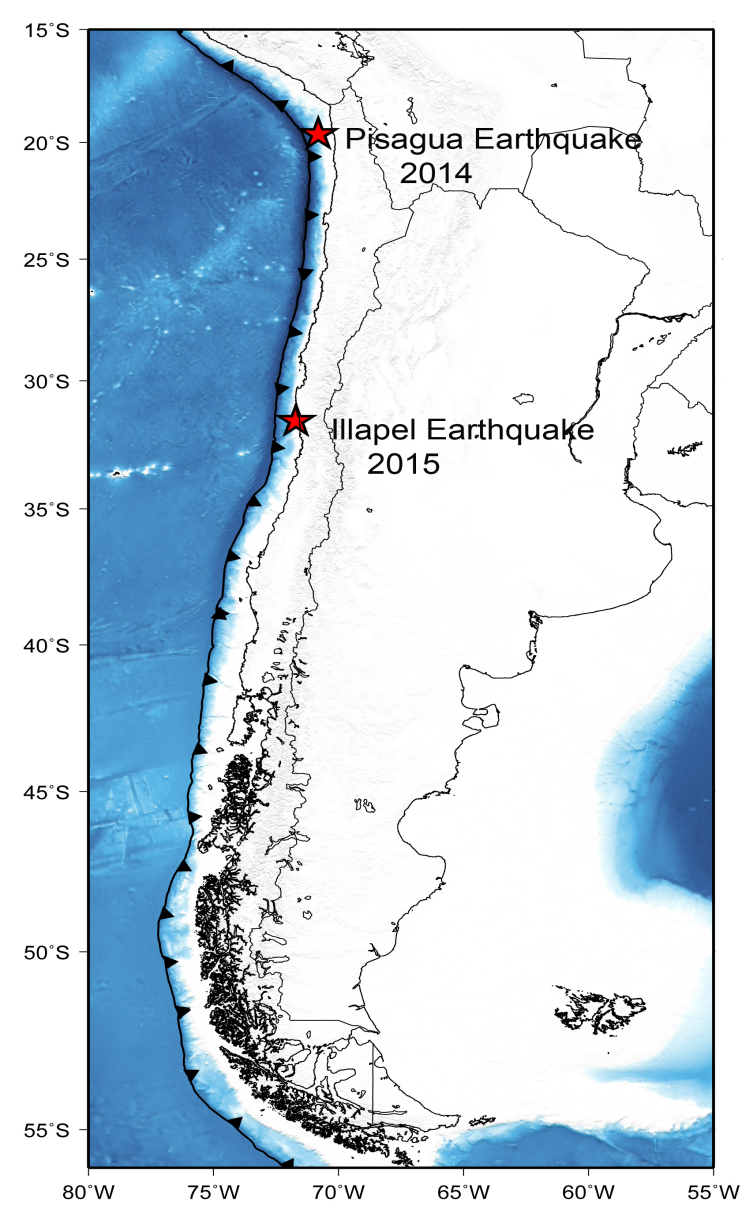
Coseismic

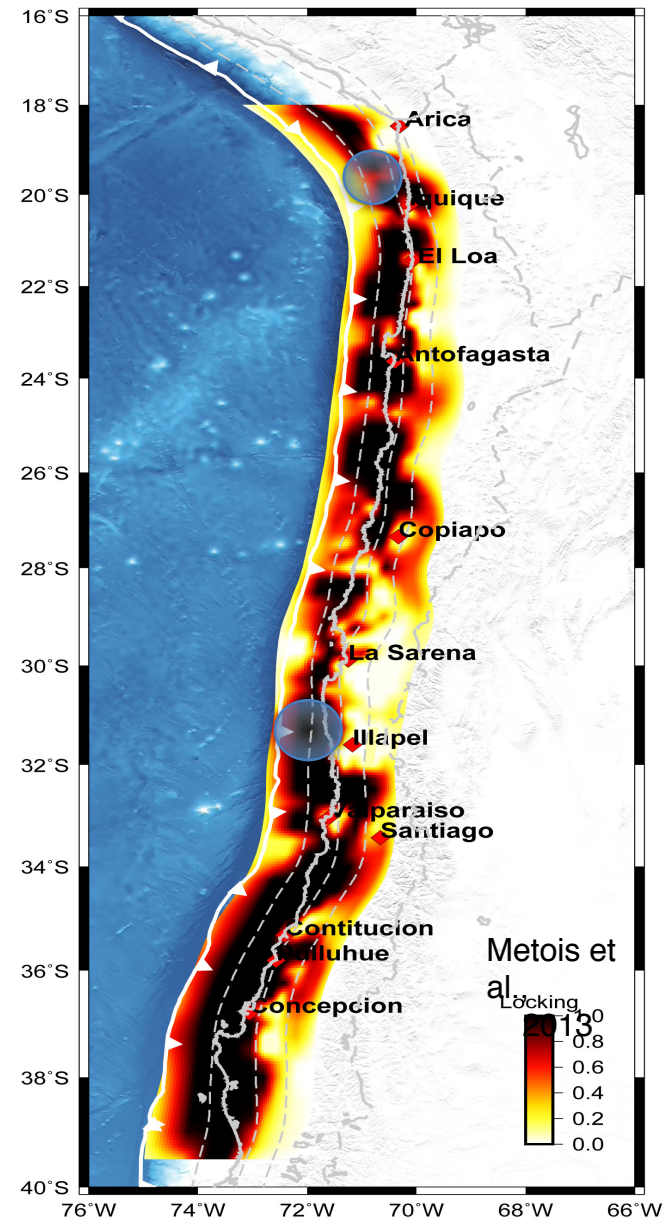


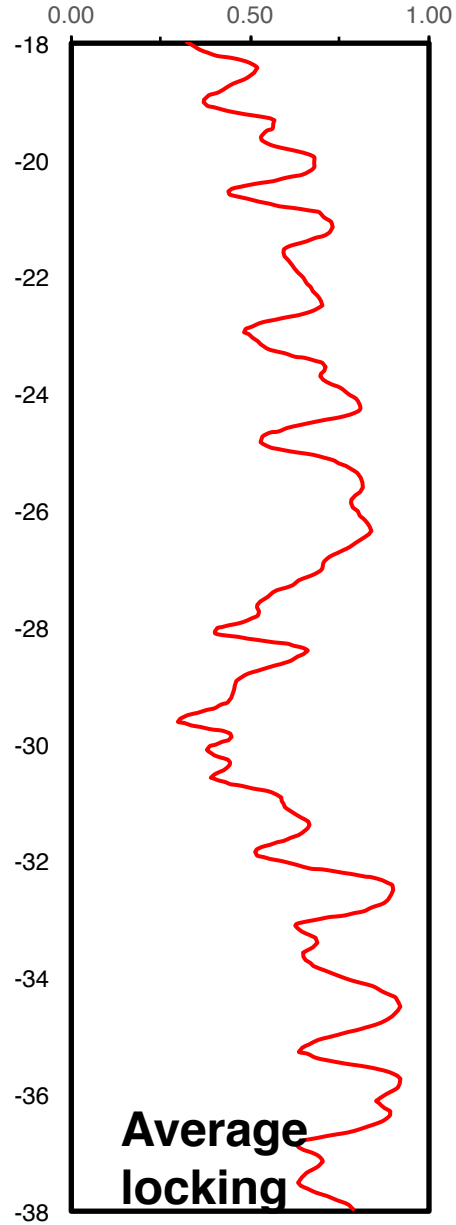
2 years of postseismic



Mahesh Shrivastava, Gabriel González, et al. (2016). (*GRL*)



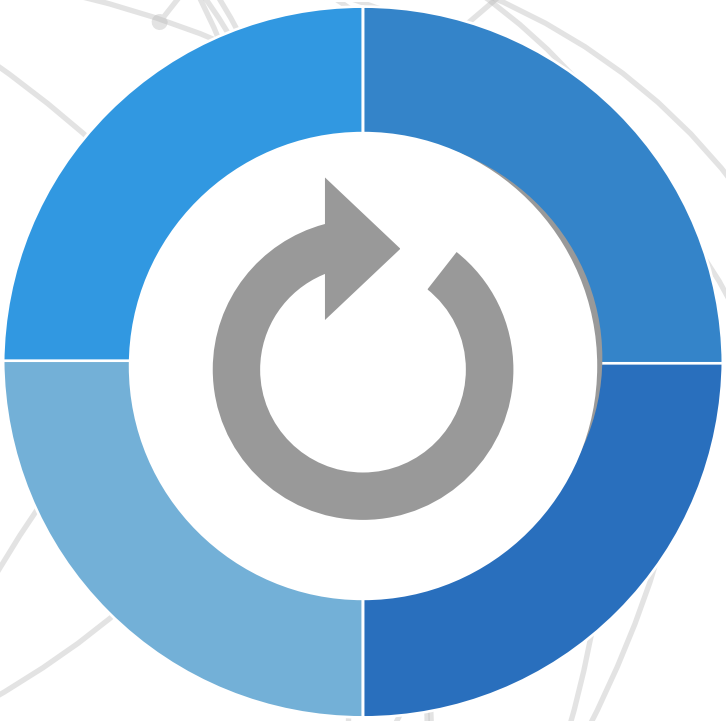




Metois et al. (2012)

Emergency:
Early Warning Systems

Hydrodynamics:
Source characterization
Tsunami modeling
Physical Processes
Edge waves
Resonance



Context and Impact
History
Recurrence
Social and physical interactions
Hazard Assessment

Mitigation and Preparedness
Guidelines
Evacuation
Structural Vulnerability
Education and Outreach

Formal Commitments to Funding Agency (5Yr) aka Work Plan

Coastal Processes and Hazards at Multiple Spatio-Temporal Scales			
Activity	**Result**	**Y6**	**Y7**
Development of a methodology to incorporate single-scenario uncertainty		X	X
	A methodology for single-scenario uncertainty		X
Development of catalog and database of relevant sources to establish earthquake recurrence models, and tsunami numerical simulations		X	
Estimation of probabilistic tsunami hazard based on global data		X	X
Incorporation of single-scenario uncertainties in the PTHA			X
	Probabilistic Tsunami Hazard Assessment along the subduction zone		
Development of Tsunami Inversion methodology		X	X
Development of estimation of uncertainty estimates			X
	Inversion methodologies with uncertainty estimates		
Design and benchmarking of modeling strategy for NRT along the Chilean coast		X	X
Incorporation of uncertainties in NRT assessments			
	NRT methology with uncertainty estimates		
Development of methodologies for multi-hazard assessment including concatenated effects			X
	Coupled seismic and tsunamigenic hazard assessment for risk analysis in single-scenarios		
Integrated assessment of flood, tsunamigenic, and storm surge hazards for the cities of Valparaiso, Viña del Mar, and Chañaral		X	X
	Multi-hazard diagnostic for studied cities		
	Proposals of hazard-mitigation alternatives for the studied cities		

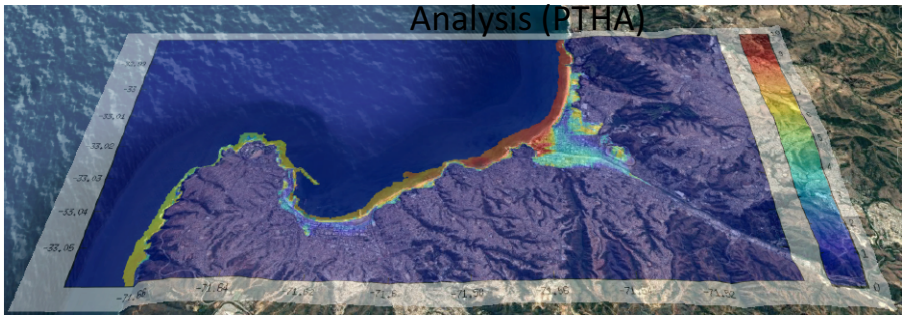
WP4		Risk and Resilience of Complex Systems and Networks
	RL	Activity / Result
A4.1	3	Consistent hazard and model for risk quantification of spatially distributed networks and complex systems
A4.2	3	Risk and resilience evaluation using physics based models of complex systems and distributed networks
A4.3	3	Risk and resilience evaluation in synthesized graphical models of distributed interdependent physical networks and complex systems
A4.4	3	Risk and resilience evaluation at urban scale in physics-based distributed interdependent physical networks and complex systems
A4.5	3	Research outreach and public communication of results
A4.6	3	Management of WP4 and interconnectivity inter-cluster and intra-work package
R4.1	3	Complete characterization of natural hazards (e.g., earthquake, tsunami) for network analysis including up-to-date recurrence relationships, IM prediction equations, spatial correlation of IMs, and effective risk and resilience evaluation algorithms
R4.2	3	Dynamic exposure model for three distributed networks in central Chile treated as independent systems, physics-based simula models for calculation of vulnerability, risk, and resilience, and general physics-based risk models of the (independent) network
R4.3	3	Graphical models for risk and resilience evaluation of distributed networks and complex systems, including in the analysis the p interdependencies and cascading effects
R4.4	3	Comprehensive integrated model for risk and resilience evaluation of central Chile including interdependencies and cascading among physical networks and the resulting effects (e.g. debris generation) on other human processes such as evacuation, or e
R4.5	3	Generation of complex scenarios for central Chile used for risk and resilience research purposes of other research lines and cl well as help improve resilience of people and communities by informing them better, evaluating different mitigation measures, providing a quantitative framework for disaster planning

Risk and Resilience of Urban Settings	
Activity	Result
Comprehensive risks models at appropriate urban scales for two large urban settings Valparaiso-Viña and Santiago	
Risk and reEfficient urban planning and information systems to identify good practices and programs in cooperation with local communities	
New public policies, planning instruments and implementations plans to achieve a larger natural disaster resilience of urban settings.	
Real-world data and ground-based knowledge to develop and test improved scenarios for the resilience of the built environment.	
	Hazus and Openquake models for the cities of Santiago and Valparaiso-Viña
	Observatory to exchange good practices in urban planning and programs
	Criteria to account for risk and resilience in urban design
	SDI (Spatial Data Infrastructure) 2.0 aimed to resilience of the built environment
	Guidelines for implementation or urban improvements leading to increased resilience to natural hazards in the Santiago and Vi
	Viña conurbations
	Research publications

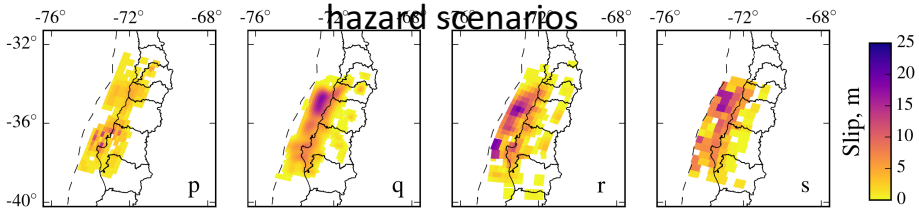
Natural Systems and Processes Cluster

Coastal Processes and Hazards at Multiple Spatio-Temporal Scales

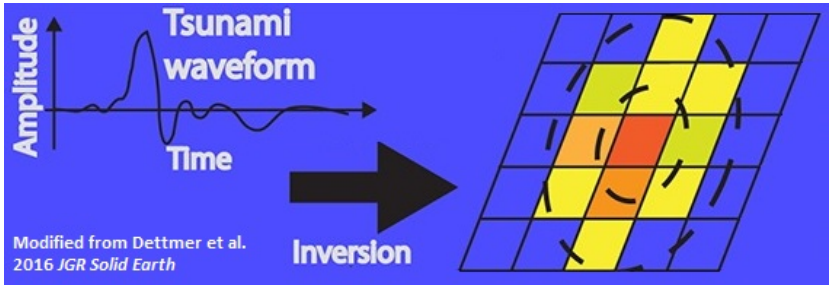
Probabilistic Tsunami Hazard Analysis (PTHA)

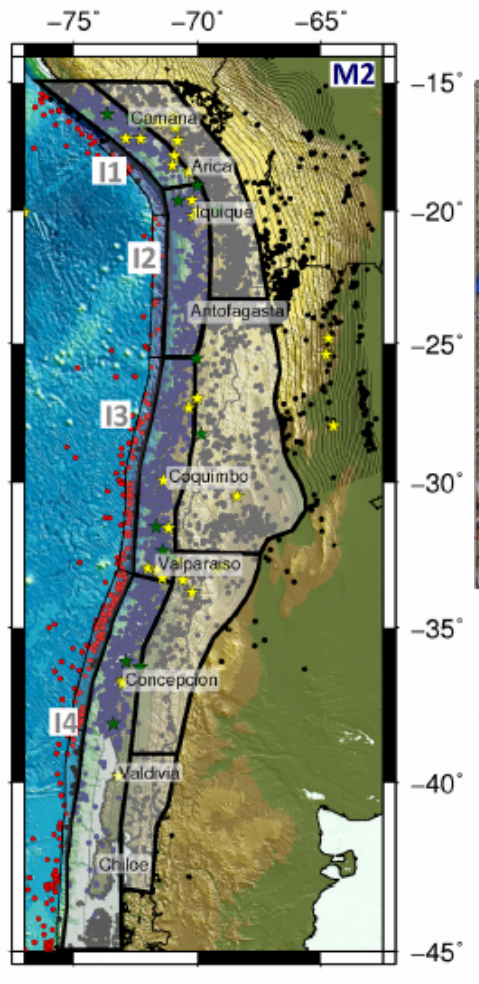


Tsunamigenic seismic hazard scenarios

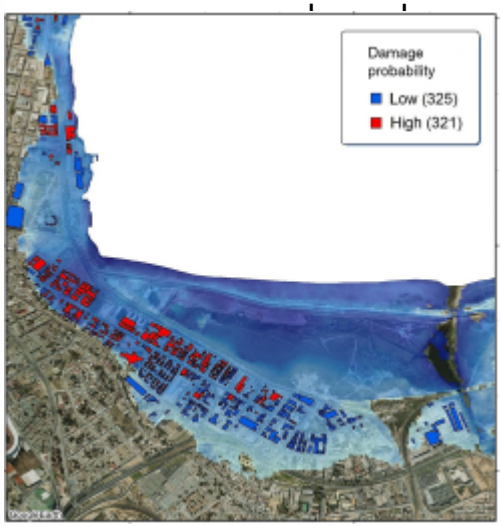


Uncertainty estimation for





Multi-



Cascadi ng zards

In reality, Trying to tackle the tsunami from many perspectives

- Physics
  - Resonance, edge waves and tsunami attenuation at large scale
- Early Warning Systems
  - Developed the Chilean Tsunami Warning System now operational
- Tsunami inversions in a Bayesian Framework from tide gages
- Operational NRT approaches
  - Finding the balance between accuracy and computing time for implementing in the ETWS
  - Assimilation methods

- Incorporating uncertainty in single scenario modeling
  - Developed methods for constraining uncertainty to geophysical templates such as ISC or slip deficit
- PTHA
  - Developing catalogs and zoning
  - Estimating b-parameter
  - Estimating recurrence
- How to link recurrence and single scenario variability into a hazard estimate?

- Stochastic inundation as input for damage
- Agent based modeling for evacuation

Natural Systems and Processes Cluster

Coastal Processes and Hazards at Multiple Spatio-Temporal Scales

Disciplines

Civil Engineering
Engineering Seismology
Geology
Geophysics
Hydraulic Engineering
Mathematical Engineering
Mechanical Engineering
Ocean Engineering
Oceanography
Architecture (Urban)

Dr. P. Winckler

Dr. J. León

P. Navarrete