CIGIDEN

Research Center for Integrated Disaster Risk Management

Heavy Rainfalls in Central Chile: Pilot Study in Quebrada de Ramón

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WATER CONGRESS 2020
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Centro de Investigación para la Gestión Integrada de Riesgos de Desastres

CONICYT Ministerio de Educación
Gobierno de Chile

EX UMBRA IN SOLEM

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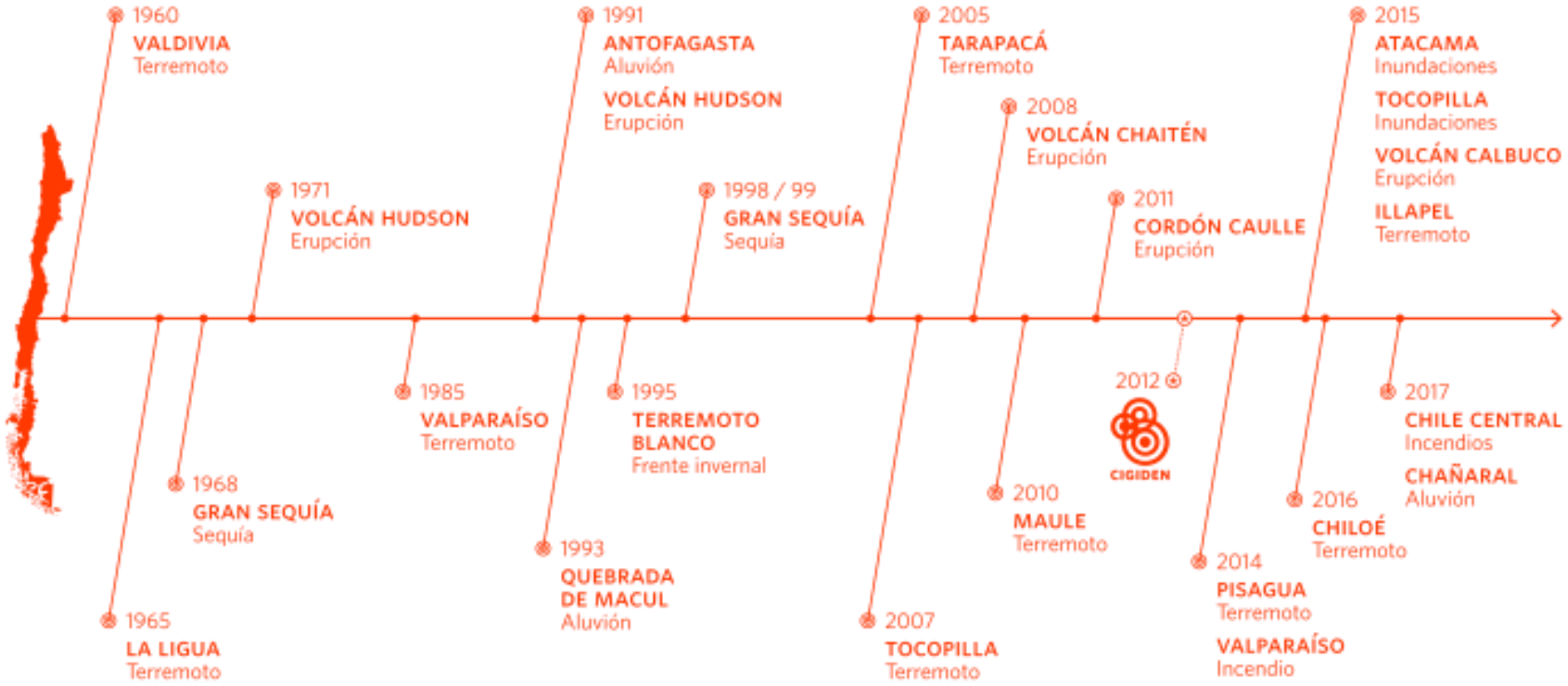
CHILE: HIGH EXPOSURE TO NATURAL HAZARDS

Global south country highly exposed to multiple natural hazards

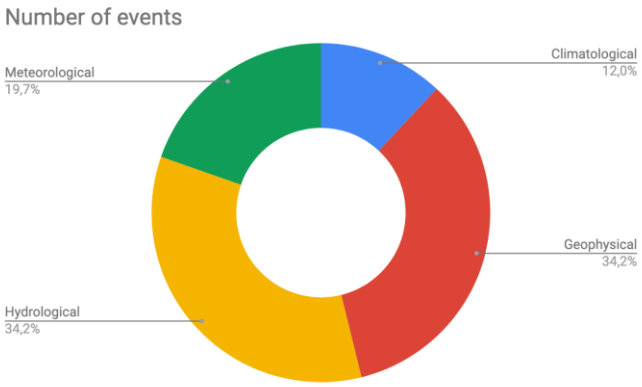
International laboratory for disaster sciences

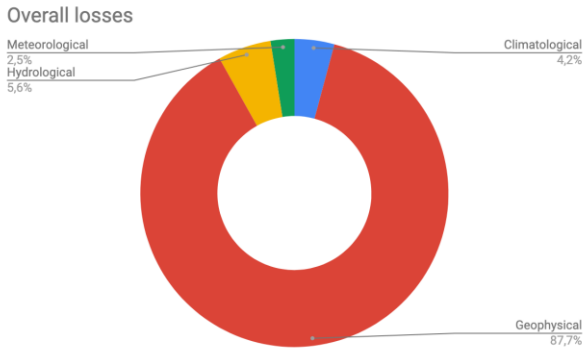


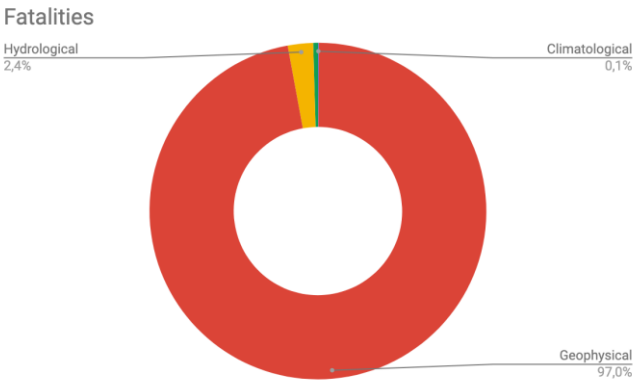
Source: CIGIDEN 2017

NATURAL HAZARDS AND IMPACTS IN CHILE

1906-2018



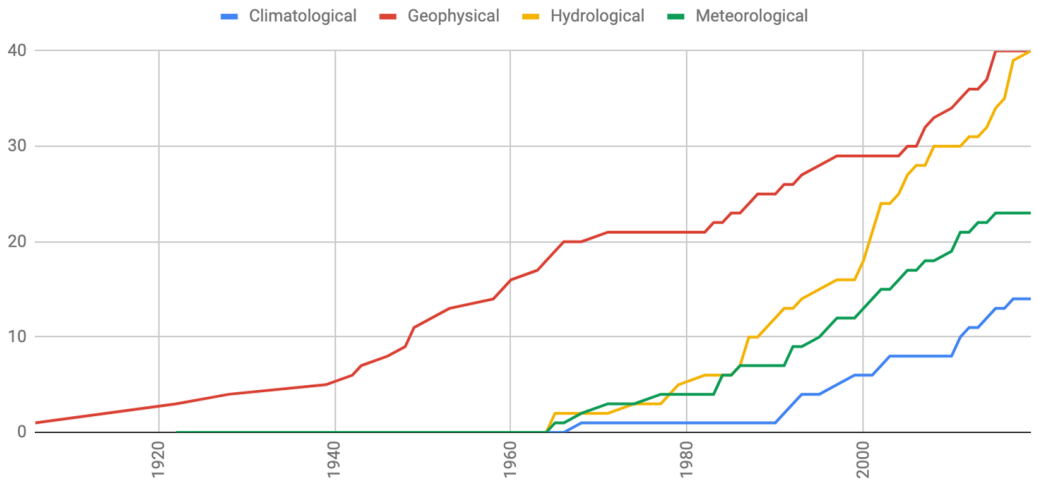




Se cumple al menos 1 de las siguientes condiciones:

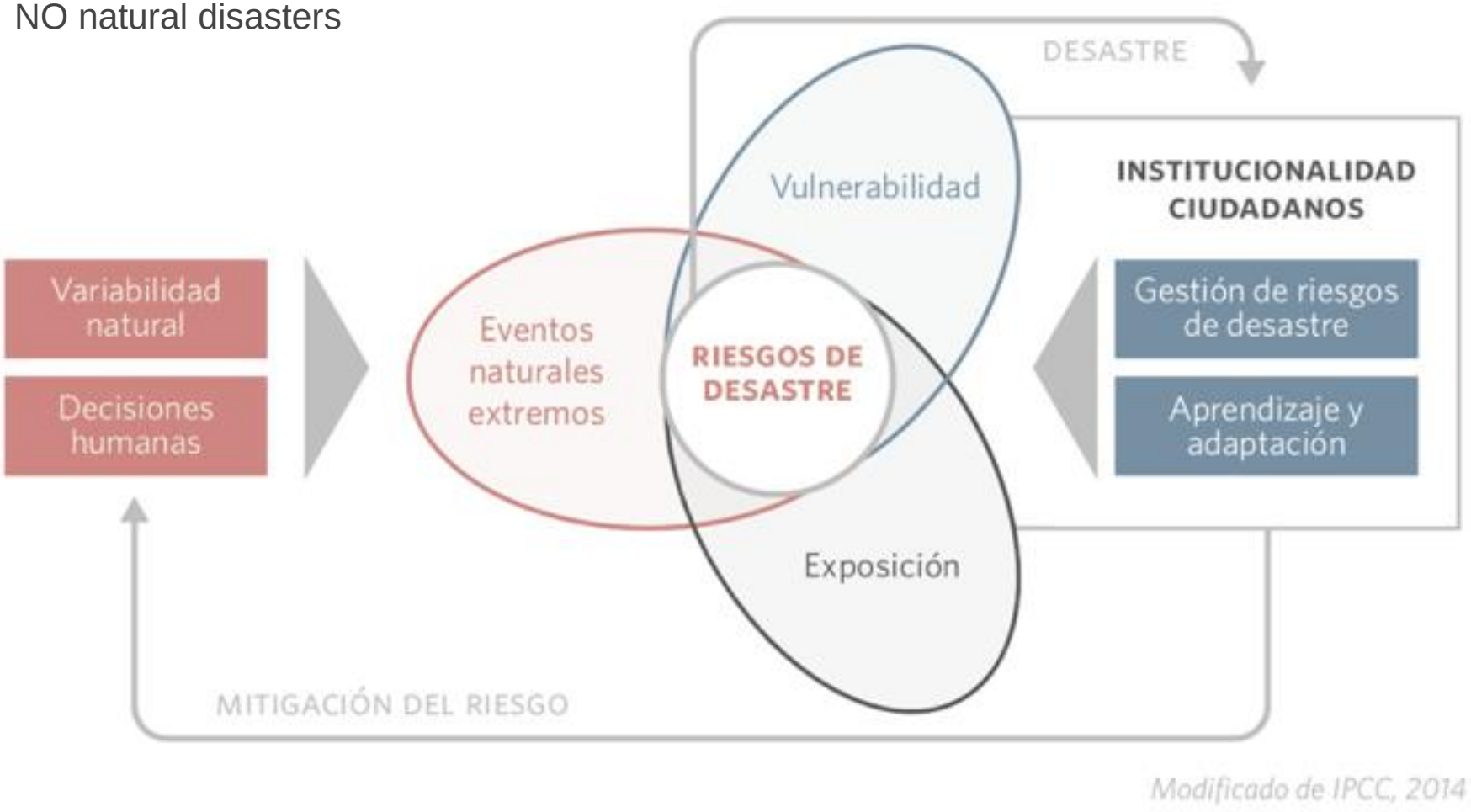
- 10 o más personas fallecidas
- 100 or más personas afectadas
- Declaración de estado de emergencia
- Solicitud de ayuda internacional

Source: EM-DAT 2019



SYSTEMIC RISKS AND GOVERNANCE

NO natural disasters



CIGIDEN

- 4 Chilean Universities
- 8 Principal Researchers
- 17 Associate Researchers
- 34 Professionals
- 13 Postdoctoral Fellows
- 20 Sponsored MSc Students
- 26 Sponsored PhD Students

Researchers from other six Chilean universities

PRINCIPAL RESEARCHERS

SOCIAL PRACTICES

RL4 DISASTER CULTURES AND RISK GOVERNANCE

Manuel Tironi
Sociology & Anthropology

Paula Repetto
Disaster Behavioral Health

RL6 CITIZEN GOVERNANCE

Carolina Martínez
Geography & Territorial Planning

NATURAL SYSTEMS AND PROCESSES

RL1 SOLID EARTH PROCESSES AND ASSOCIATED HAZARDS

Gabriel González – Deputy Director
Earth Sciences & 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

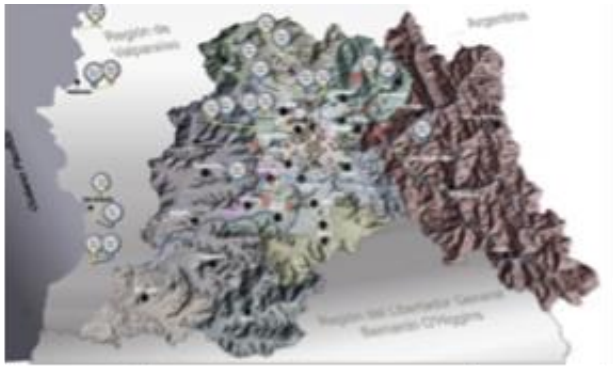
Juan Carlos De la Llera
Civil Engineering/Risk Resilience of Physical Systems

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

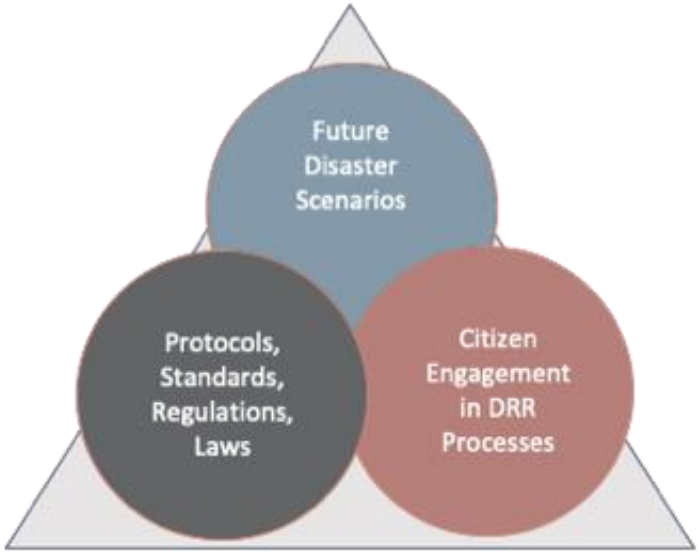
NEW MODEL FOR KNOWLEDGE EXCHANGE



Prospective Risk Assessment

Institutions (national and regional scales)

- Resilience of critical infrastructure networks.
- Urban and territorial planning for DRR, resilience, and sustainability.
- Socio-economic dimensions



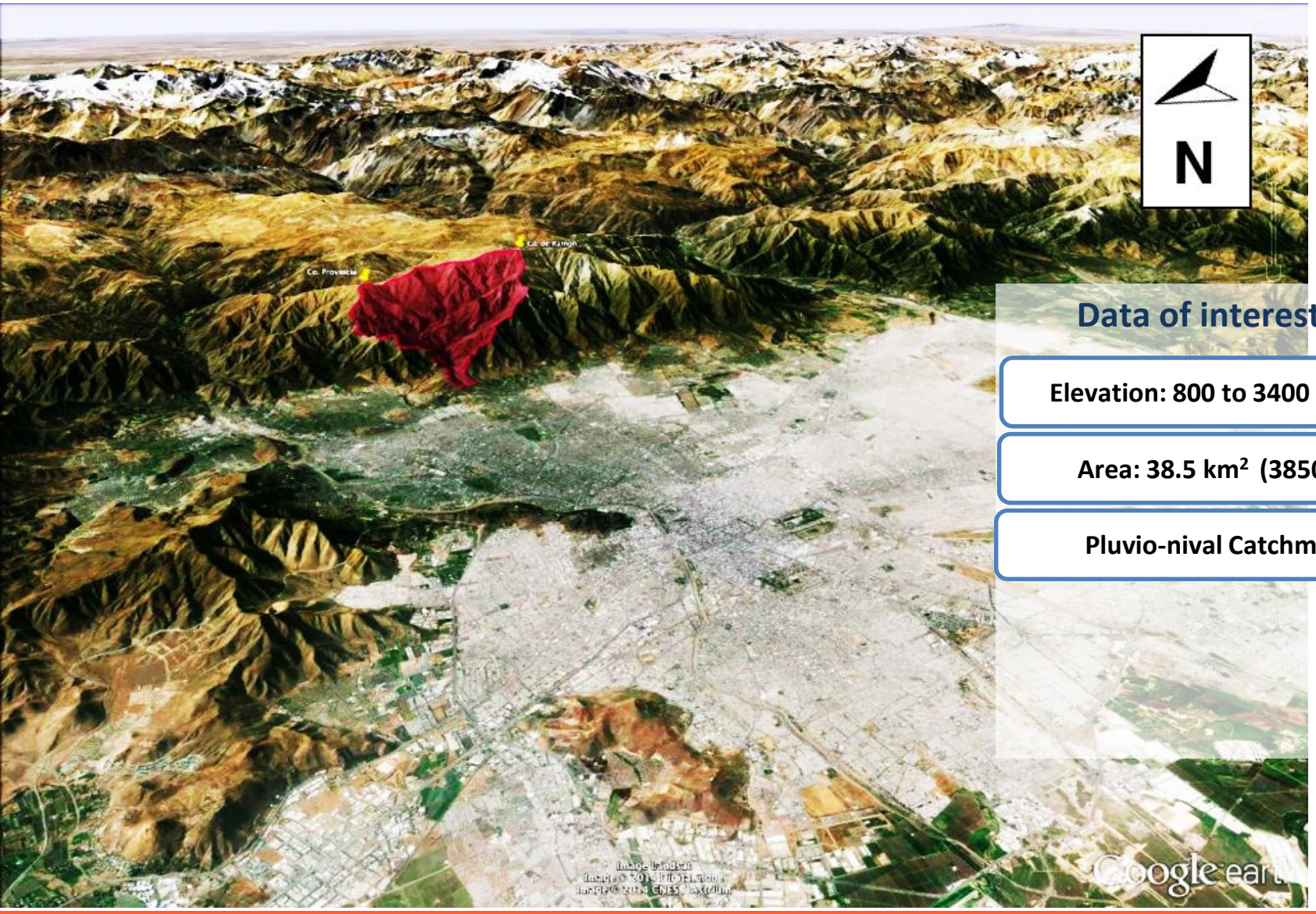
Communities (local scales)

- Appraisal of social practices and contextual cultural heritages.
- Knowledge exchange and dialogues with local communities.
- Education and participation.

PILOT STUDY

Early Warning System for Flash Floods

QUEBRADA DE RAMÓN, A REPRESENTATIVE SMALL ANDEAN CATCHMENT



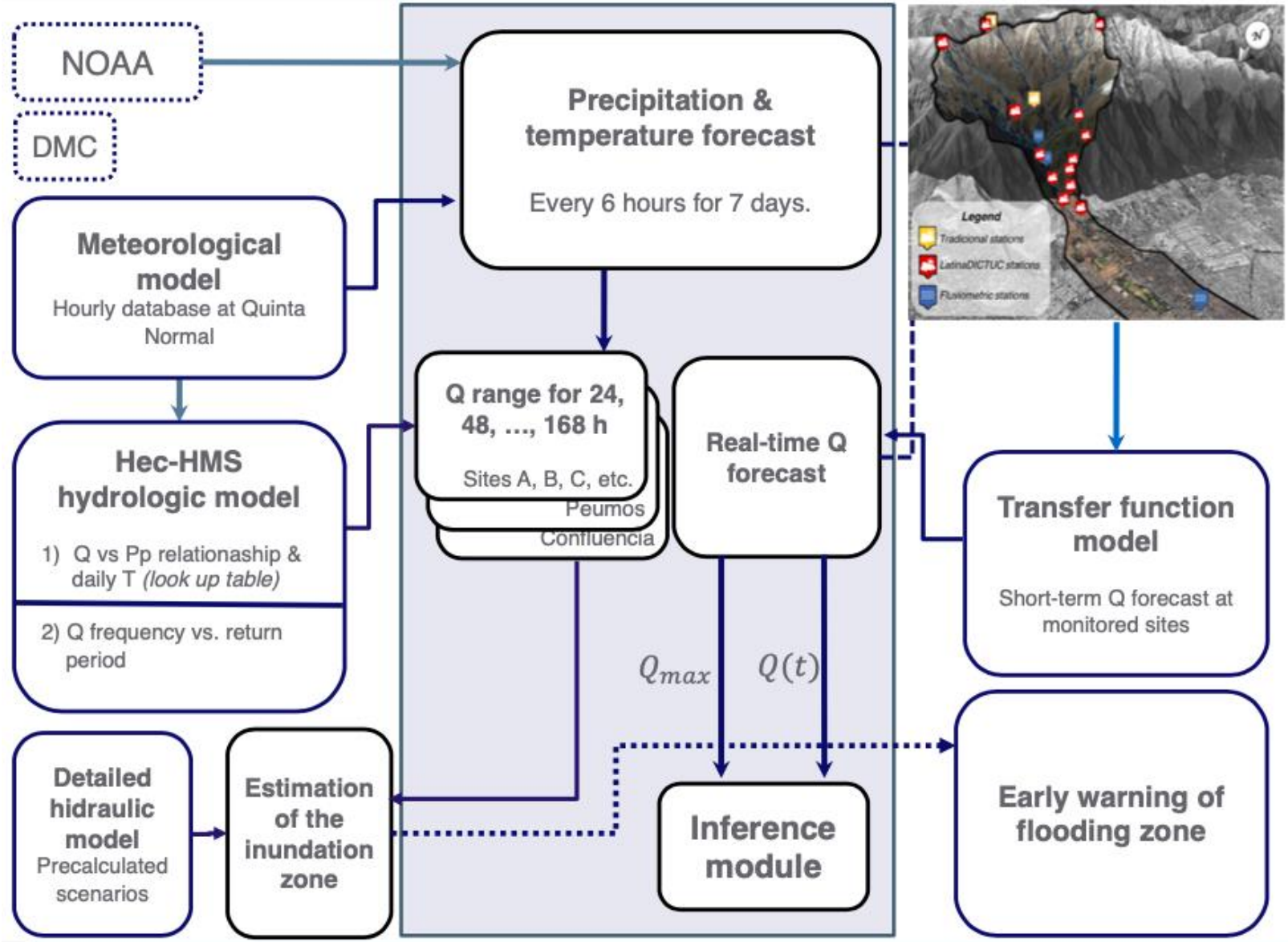
Data of interest

- Elevation: 800 to 3400 m.a.s.l.
- Area: 38.5 km^2 (3850 ha)
- Pluvio-nival Catchment

QUEBRADA DE RAMÓN, A REPRESENTATIVE SMALL ANDEAN CATCHMENT

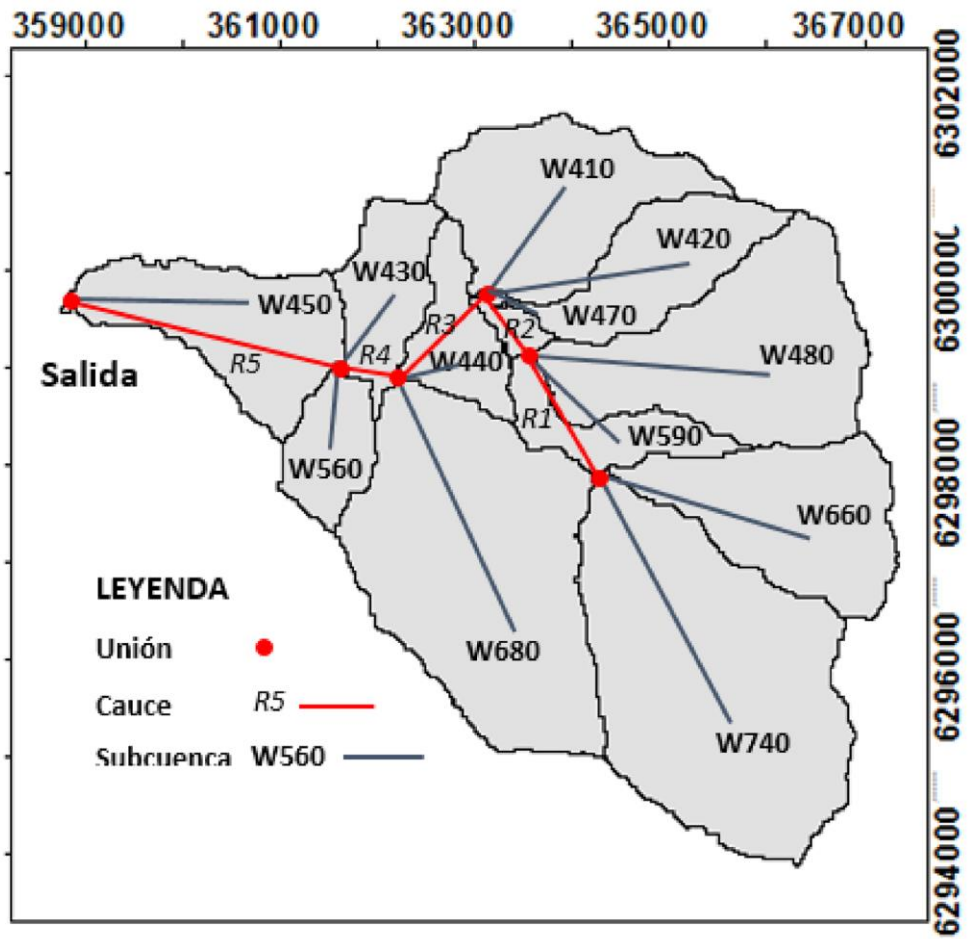
- Frequent and documented historical records
- Large exposed urban population
- Appropriate size for research purposes
- Proximity and easy of access for scientific campaigns
- Controlled public access
- Sensitive to height-temperature variations (Zero isotherm)
- Adequate for pilot testing

REAL TIME MONITORING SYSTEM & FLOOD FORECAST

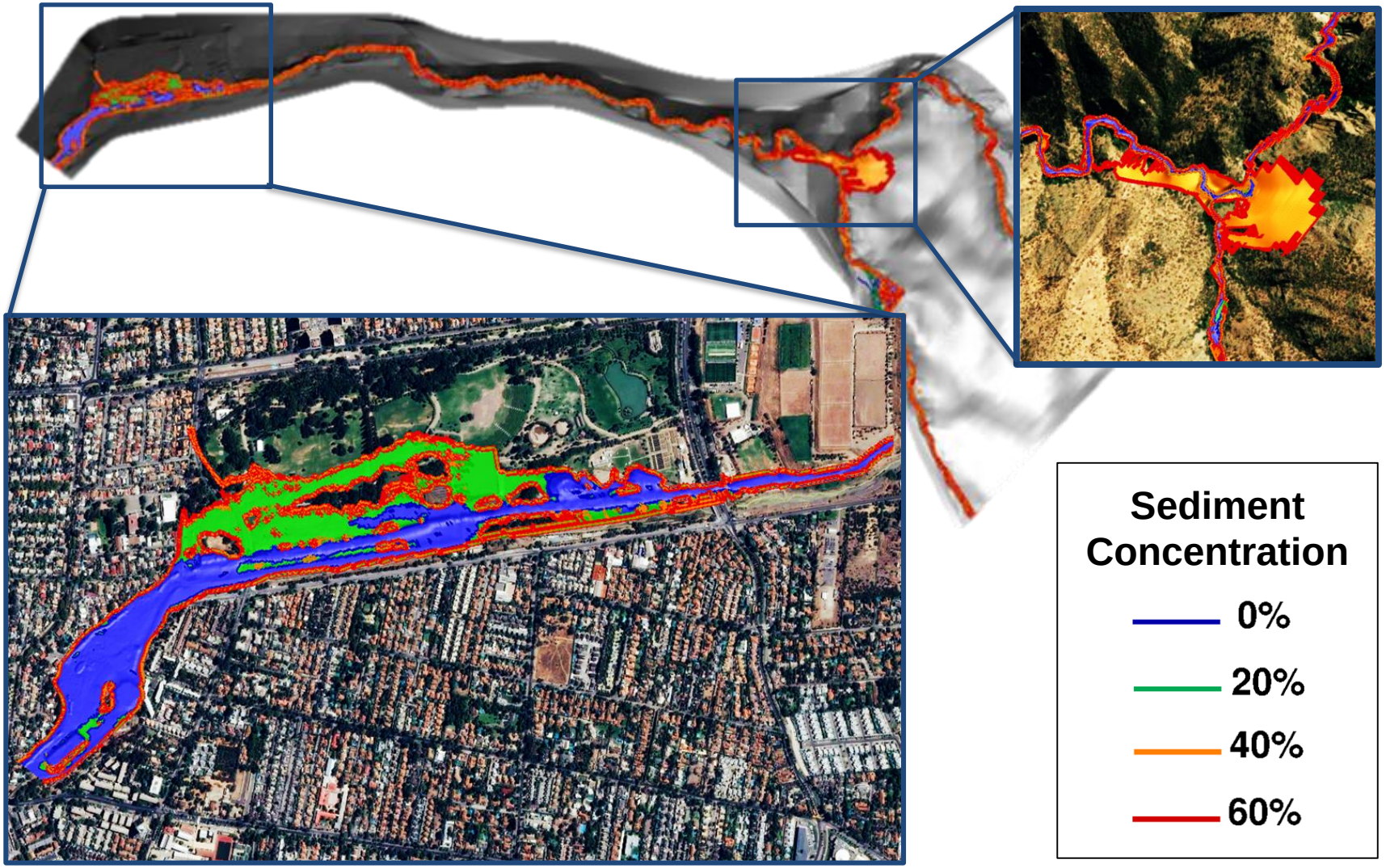


HEC-HMS HYDROLOGICAL MODEL

- **Historical Record:**
  - Rainfall and Temperature in Quinta Normal Station (1971 – 2010)
  - Temporal Disaggregation of daily values to hourly values
  - Spatial extrapolation to subcatchments
- **Topography:** 2 meters Digital Elevation Model grid size.



HYDRAULIC AND SEDIMENT CONCENTRATION MODELING



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STATISTICAL FORECAST FOR FLOOD DEPTHS

Objective: Hourly or finer Forecast with quick incorporation of real-time data (Flow, Temperature, Rainfall, Soil Moisture, etc.)

Regression Model:

$$\mathbf{H}_t = \beta_0 + \beta_1 \mathbf{X}_1 + \beta_2 \mathbf{X}_2 + \beta_3 \mathbf{X}_3 + \cdots, \quad i = 1, \ldots, n.$$

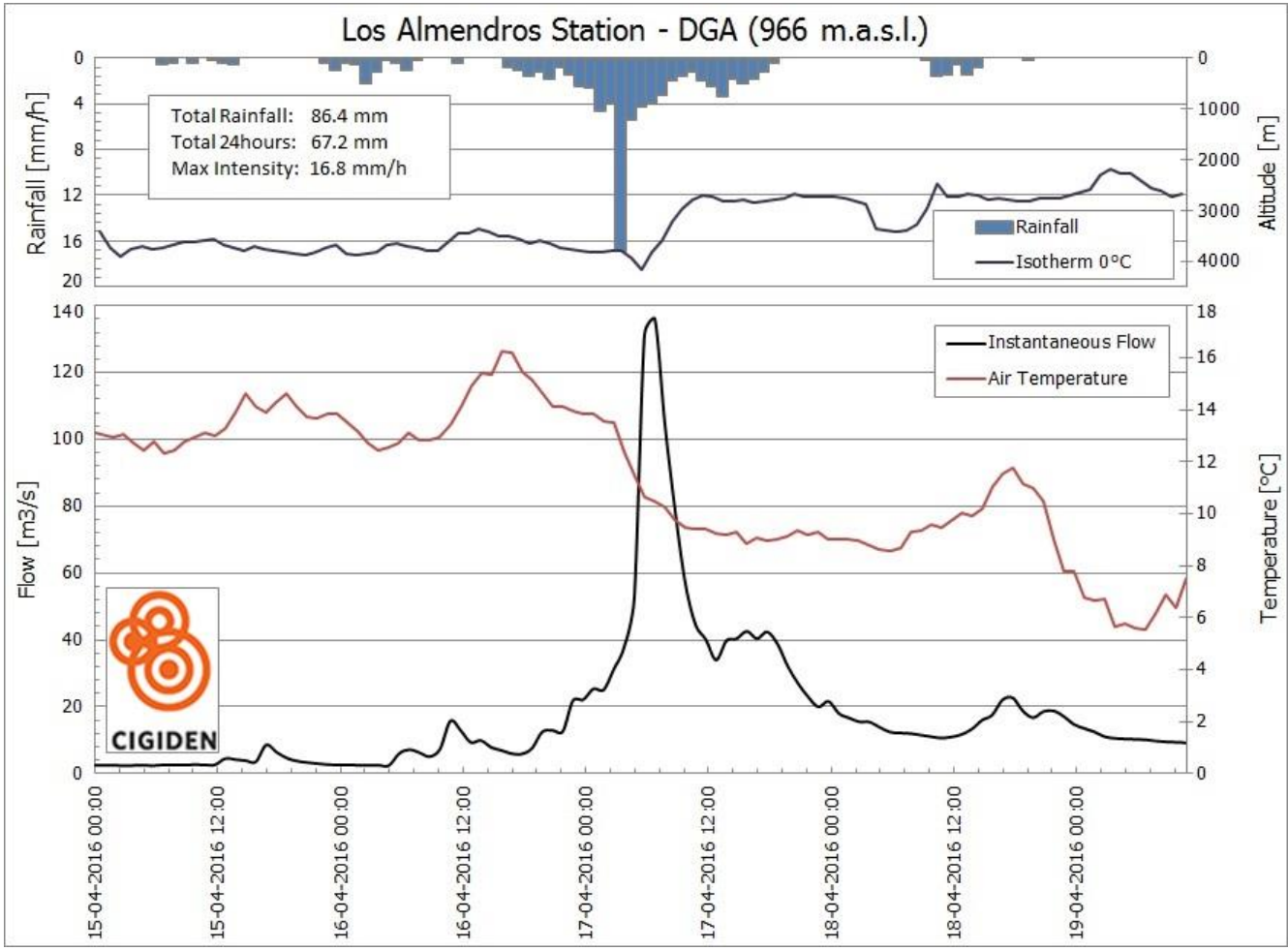
Forecasted Flow depth

Regression Coefficients

Selected variable data: Rainfall, Temperature, Upstream Flow, etc.

OBSERVATIONS FOR APRIL 2016
HEAVY RAINFALL

- Abnormal Rainfall Amount
- High Intensity peak
- Isotherm 0°C at high altitude
- Quebrada de Ramón drainage system at maximum capacity
- Large flooding in Santiago



INSTITUTIONAL CHALLENGES

CLIMATE CHANGE & EXTREME EVENTS

- Sparse institutional framework
    - DMC, MOP-DGA-DOH, MMA, SERNAGEOMIN-ONEMI
- Data and information integration
- Need for monitoring at higher resolutions
- Until now main focus on water resources management, not in disaster risk management
- Huge challenge for infrastructure management and adaptation to climate change
- Opportunities for Government-Universities-Private Sector-NGOs consortiums
- Technological and social innovation for disaster risk management

ACKNOWLEDGEMENTS

CIGIDEN

Research Center for Integrated Disaster Risk Management

LATINA
LABORATORIO DE TECNOLOGÍAS INALÁMBRICAS UC

PARQUE CORDILLERA

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Ministerio de Ciencia, Tecnología, Conocimiento e Innovación
Gobierno de Chile

PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE
ESCUELA DE INGENIERÍA
FACULTAD DE INGENIERÍA

CEDEUS
Centro de Desarrollo Urbano Sustentable

CORFO

2030 ENGINEERING STRATEGY

Instituto Nacional de Hidráulica
Ministerio de Obras Públicas
Gobierno de Chile