

RIESGOS

MULTI-RISK ANALYSIS AND
INFORMATION SYSTEM COMPONENTS
FOR THE ANDES REGION

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and Research

Towards an integrated Framework for Distributed, Modular Multi-Risk Scenario Assessment

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* GFZ- Potsdam, Potsdam, Germany / EURAC Research, Bolzano, Italy



RIESGOS – Motivation & Goal

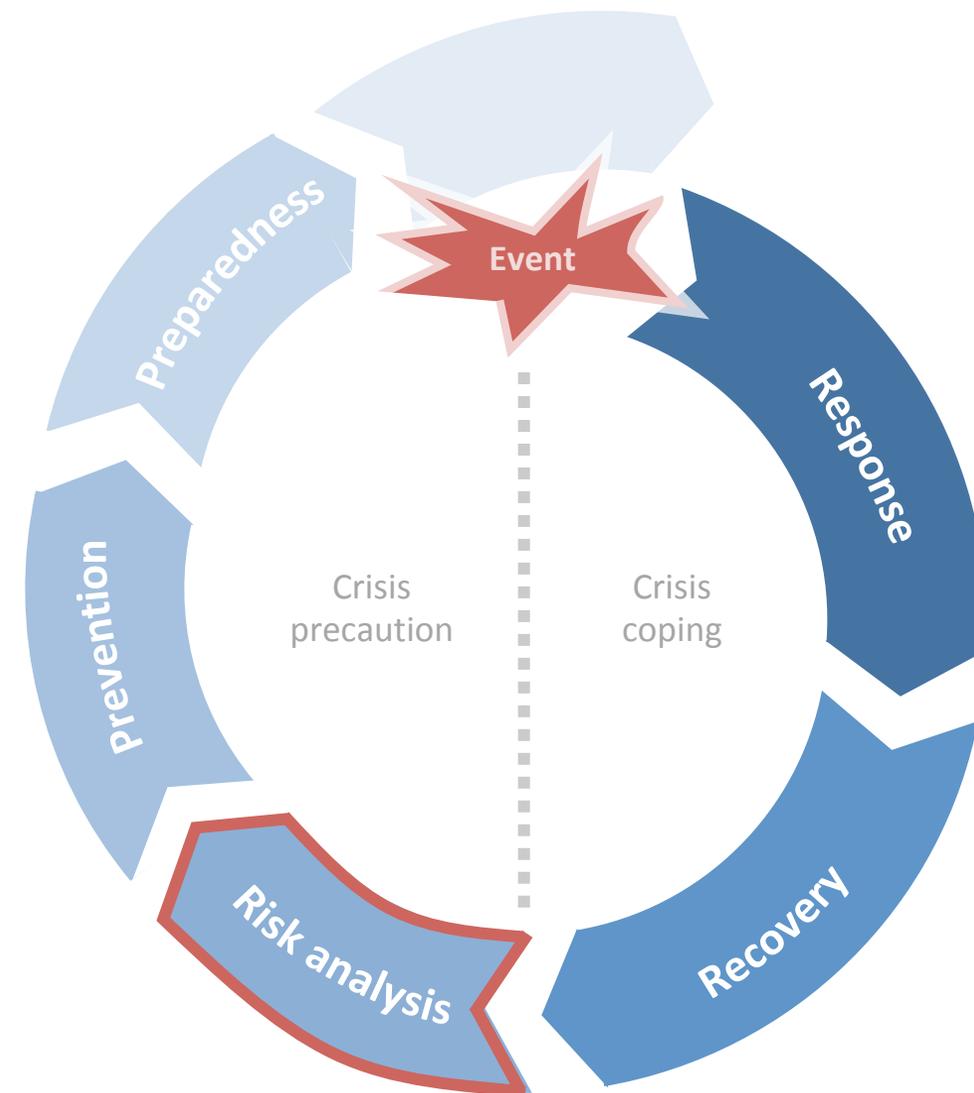
In recent decades, the risk to society due to natural hazards has increased globally. To counteract this trend, an efficient risk management is necessary, for which reliable information is essential.

From single-hazard to **multi-hazard risk assessment**, including exposure and dynamic vulnerability, and progressing towards the analysis of cascading effects



RIESGOS

MULTI-RISK ANALYSIS AND
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Multi-risk situation including cascading effects

“Story”: Earthquake, tsunami and critical infrastructure



Critical infrastructure



Vulnerability



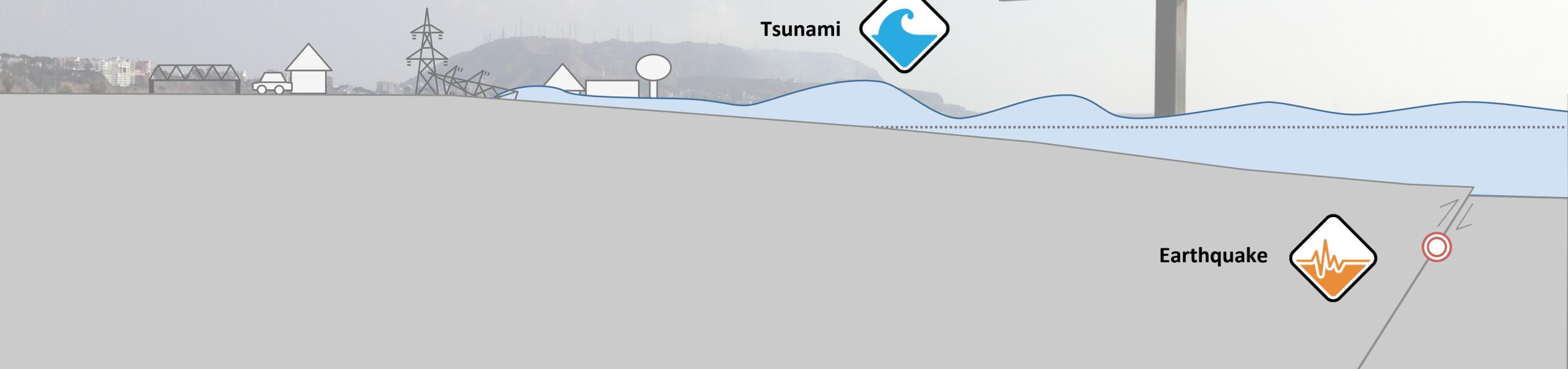
Exposition



Tsunami

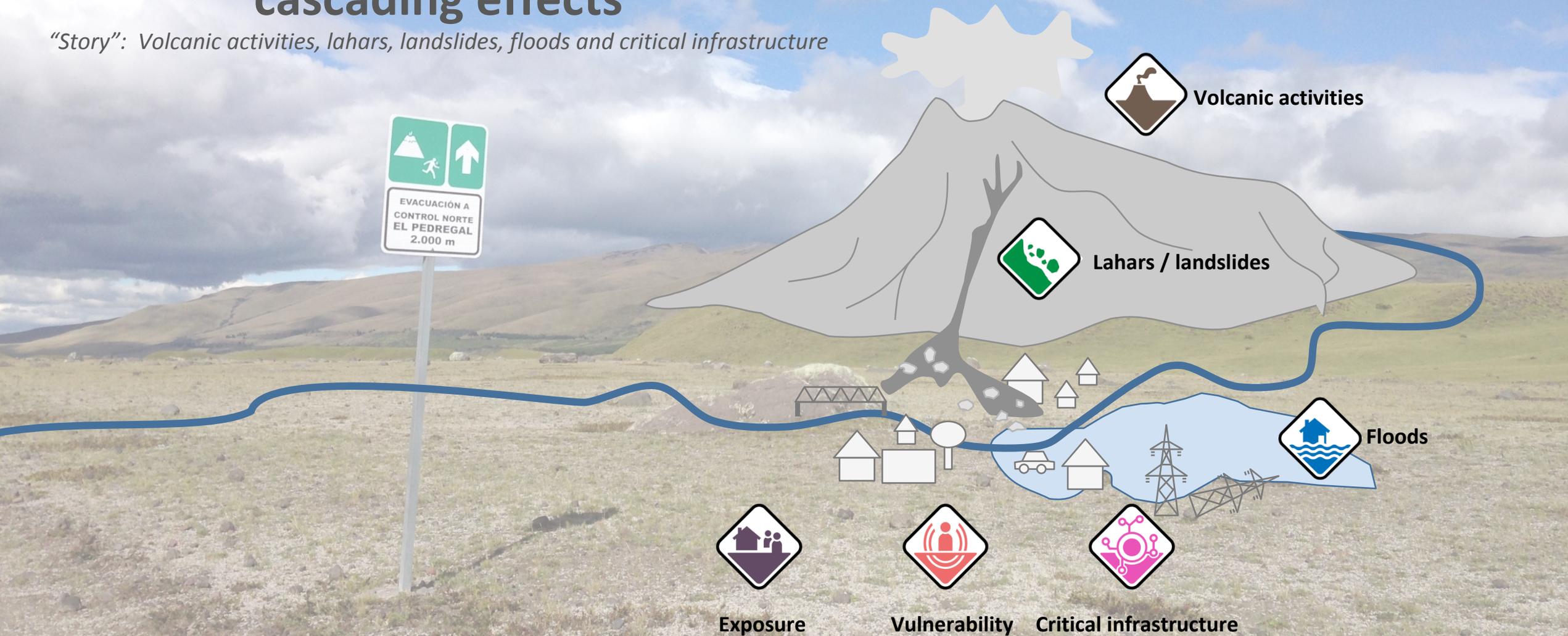


Earthquake



Multi-risk situation including cascading effects

"Story": Volcanic activities, lahars, landslides, floods and critical infrastructure



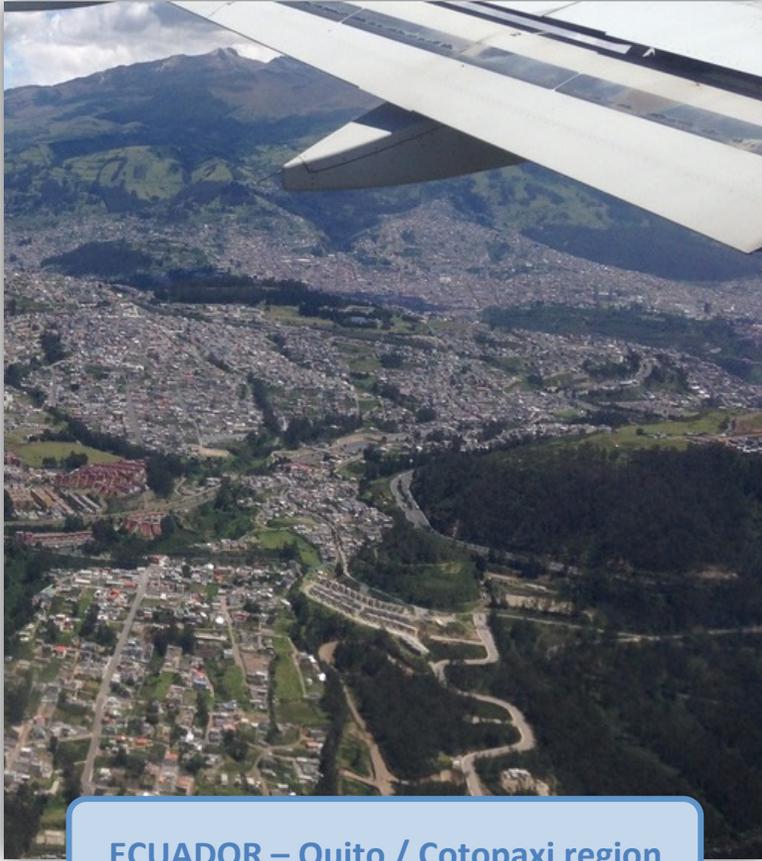
RIESGOS – Pilot regions



PERU – Metropolitan Lima and Callao



CHILE – Valparaíso region



ECUADOR – Quito / Cotopaxi region



MOTIVATION

INTERDISCIPLINARITY

Multi-hazard applications require diverse competences, background and skills, that are rarely to be found in a single institution.

COLLABORATION

Multi-risk estimation requires strong collaboration among different scientific and operational partners, often geographically distributed.

SHARED COMMITMENT

Research-focused institutions need efficient solutions to make available mature & bleeding-edge methodologies to fellow researchers and end-users.

DISTRIBUTED VS MONOLITHIC

Monolithic solutions for multi-hazard and multi-risk are difficult to develop and maintain. Distributed architectures favour objective choices in an international, collaborative framework.

OPENNESS - TRANSPARENCY

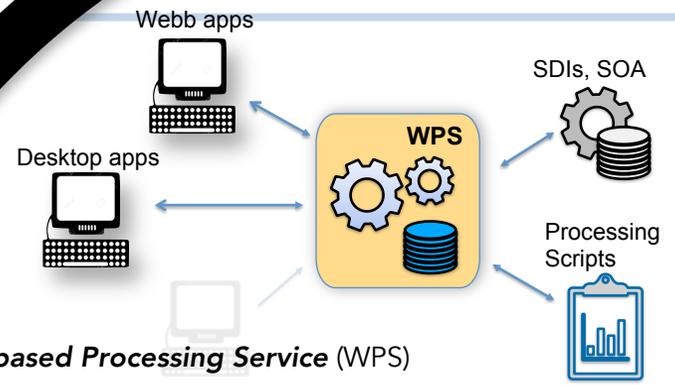
The use of standard formats and open sharing of data and methodologies. are key!

To explore the complex interplay between different natural hazards a distributed framework for multi-risk assessment has been designed



The distributed architecture is based on a set of WPSs, each implementing one or more steps of the risk assessment workflow. Each WPS can be hosted by different institutions, in different locations.

WEBSERVICES

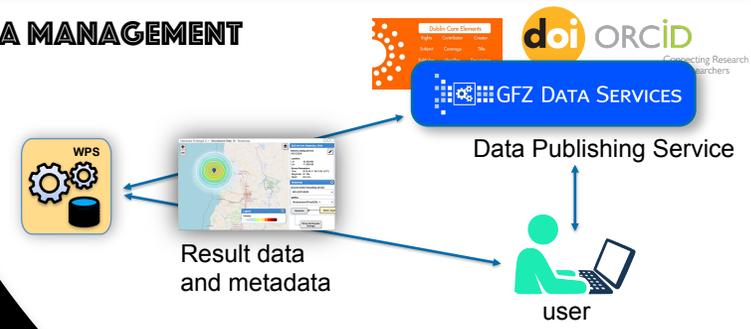


A *Web-based Processing Service* (WPS)

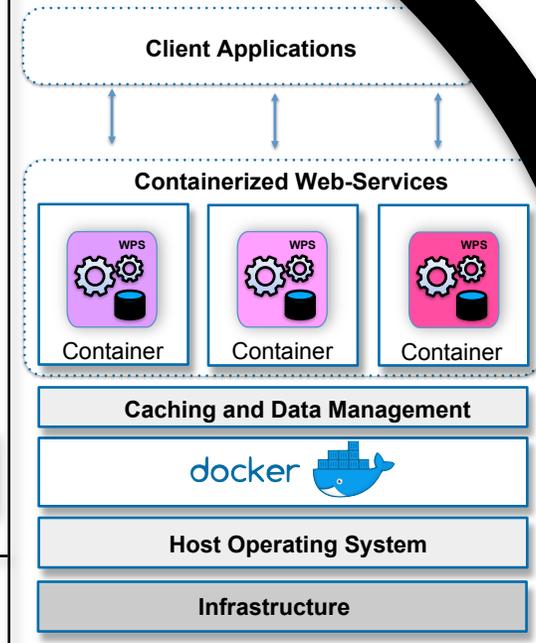
- logically represents an activity with a specified outcome
- is self-contained
- is a black box for its consumers
- may consist of other underlying services
- Open Geospatial Consortium (OGC) Standard



DATA MANAGEMENT



Each product can be directly indexed with a **persistent identifier** (e.g., a DOI) and published in a recognised public repository for referencing, dissemination and reuse.



A modular architecture has been designed to ensure a safe rapid implementation of OGC-compliant WPS. The use of docker containers allows for an efficient management of available resources and improve the scalability of the system.

ARCHITECTURE

TECHNOLOGY



RIESGOS Demonstrator: landing page (as of May 2020)

RIESGOS Demonstrator | Stories | Documentation | Licenses

This is a prototype. The information presented here is not suitable for planning or other practical applications. > | EN | GRAPH

Pilot regions

To understand, describe, and quantify multi-risk situations, RIESGOS works with stories (specific case studies) in selected pilot regions in Chile, Ecuador, and Peru. These stories represent realistic multi-risk situations with cascading effects. Please select one of the following:

Valparaíso region

Quito / Cotopaxi region

Metro

Further information can be found on the project website.

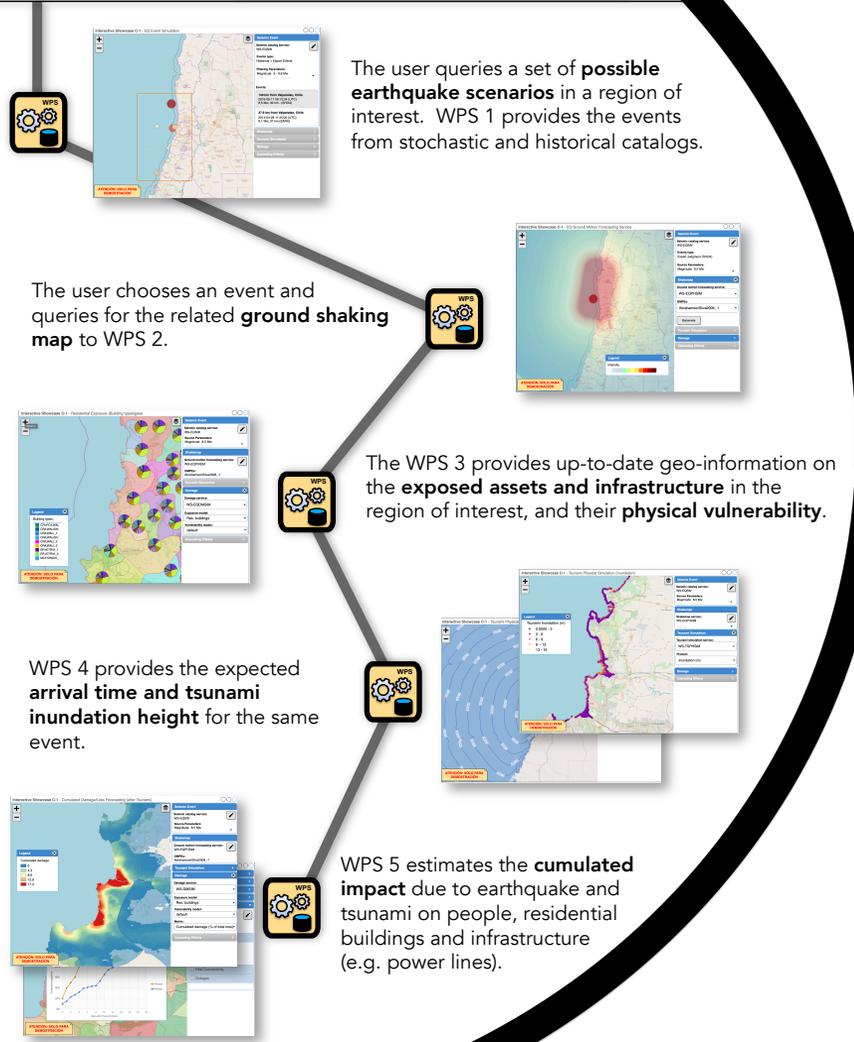
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Different WPS can be assembled in a single virtual interface, a.k.a. *orchestrator*, which can be accessed through a remote web interface. A first web demonstrator has been implemented, focusing on three case studies-



VALPARAÍSO, CHILE

SIMPLIFIED EXAMPLE !



Each case study represents a specific multi-risk scenario. For instance, earthquake+tsunami in Valparaíso, Chile.

In this case 6 different WPS hosted in three different servers in Germany are employed. The details of the individual events can be chosen by the user, in order to better explore the range of possible consequences.

Across the two consecutive events the damage and loss is accumulated

APPLICATION



The use of a distributed and modular architecture allows to streamline the application and testing of advanced scientific applications. New approaches and methodologies (e.g. for exposure and vulnerability modeling, or event simulation) can be made readily available to the scientific community as well as practitioners and end-users.

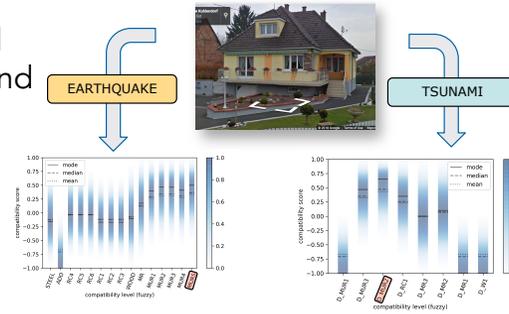
SCIENCE

EXPOSURE

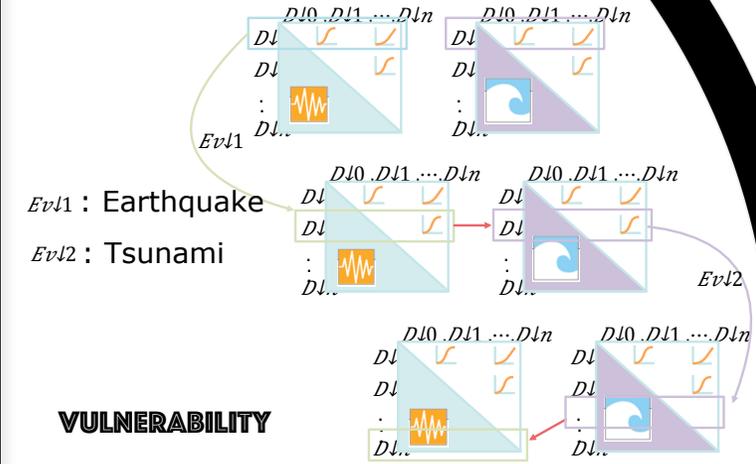


Global remote sensing products are used to reliably downscale exposure data.

Multi-hazard taxonomies and fuzzy mapping allow to create dynamic exposure models.



Multi-risk vulnerability models have to consider the state dependency in order to model the accumulation of physical damage across a sequence of (different) natural events.



VULNERABILITY

IMPACT



Impact of cascading events is considered from the physical and from the systemic perspective. Dynamic non-linear models of vulnerability and loss are employed to estimate possible consequences and also the estimated time required for the affected systems to recover their original performance.



Asistente de Configuración

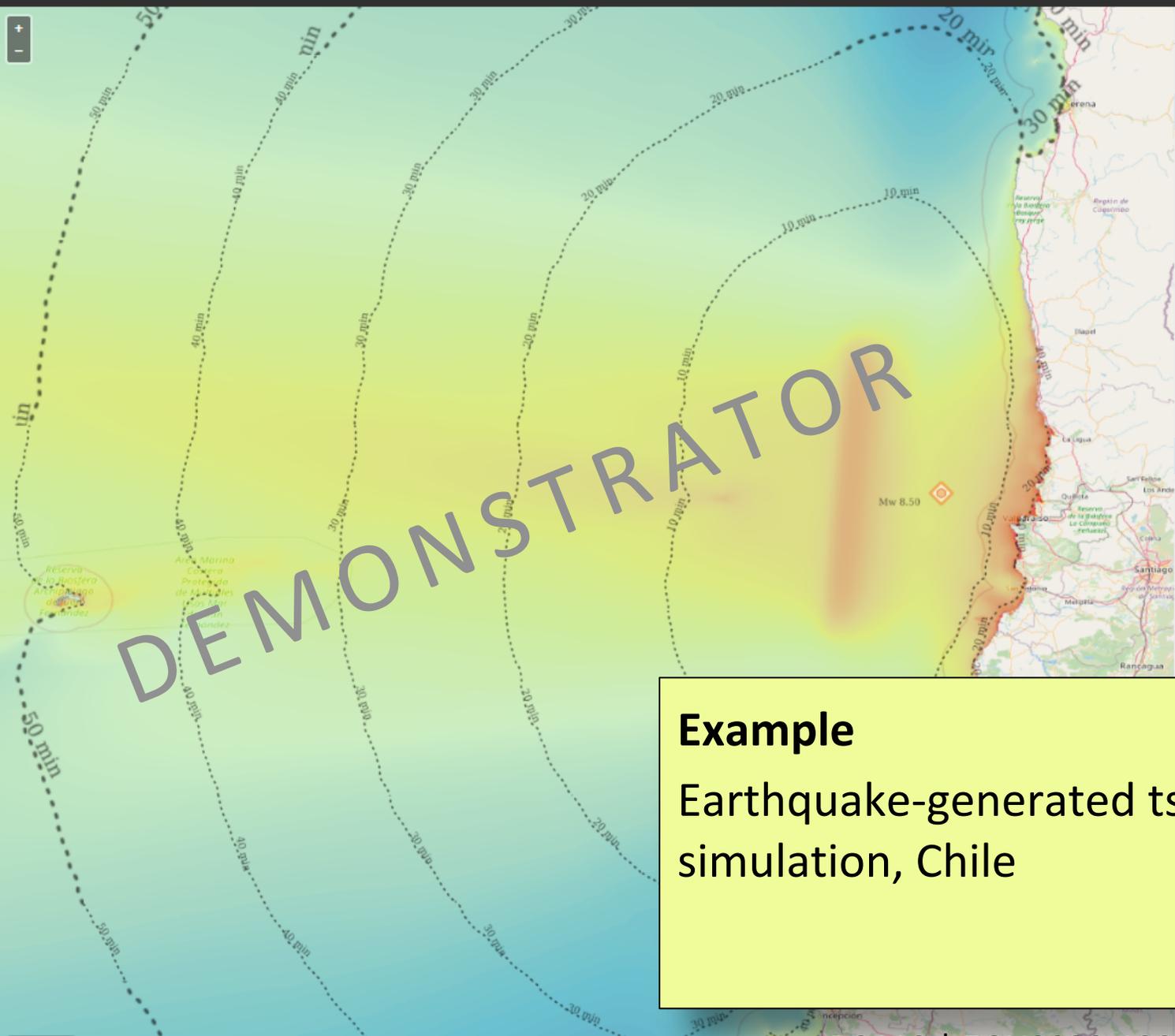
- Catálogo de terremotos Terminado
- Elija un terremoto Terminado
- Simulación de movimiento de tierra Terminado
- EQ Exposure Model Selection Preparado
- Daño post-terremoto Downstream
- Simulación de tsunami Terminado**

Simula un tsunami basado en los parámetros de terremoto seleccionados ...

Proveedor: Alfred Wegener Institute

RECONFIGURAR

- Daño post-tsunami Downstream
- Infraestructura - red eléctrica Preparado



Control de las capas

Resultados

- Tiempos de llegada
- Epicentro
- Amplitud máxima del tsunami
- Profundidad máxima de inundación - 10...
- Profundidad máxima de inundación - 10...
- shakemap

Opacidad: 0.3

Capas adicionales

- Carta de inundación por tsunami
- Servicio Civil
- Líneas eléctricas
- Sombreado
- imágenes satelitales
- OpenStreetMap

Example
Earthquake-generated tsunami simulation, Chile

Configuración

REINICIAR GUARDAR RESTAURAR

50 km

Asistente de Configuración

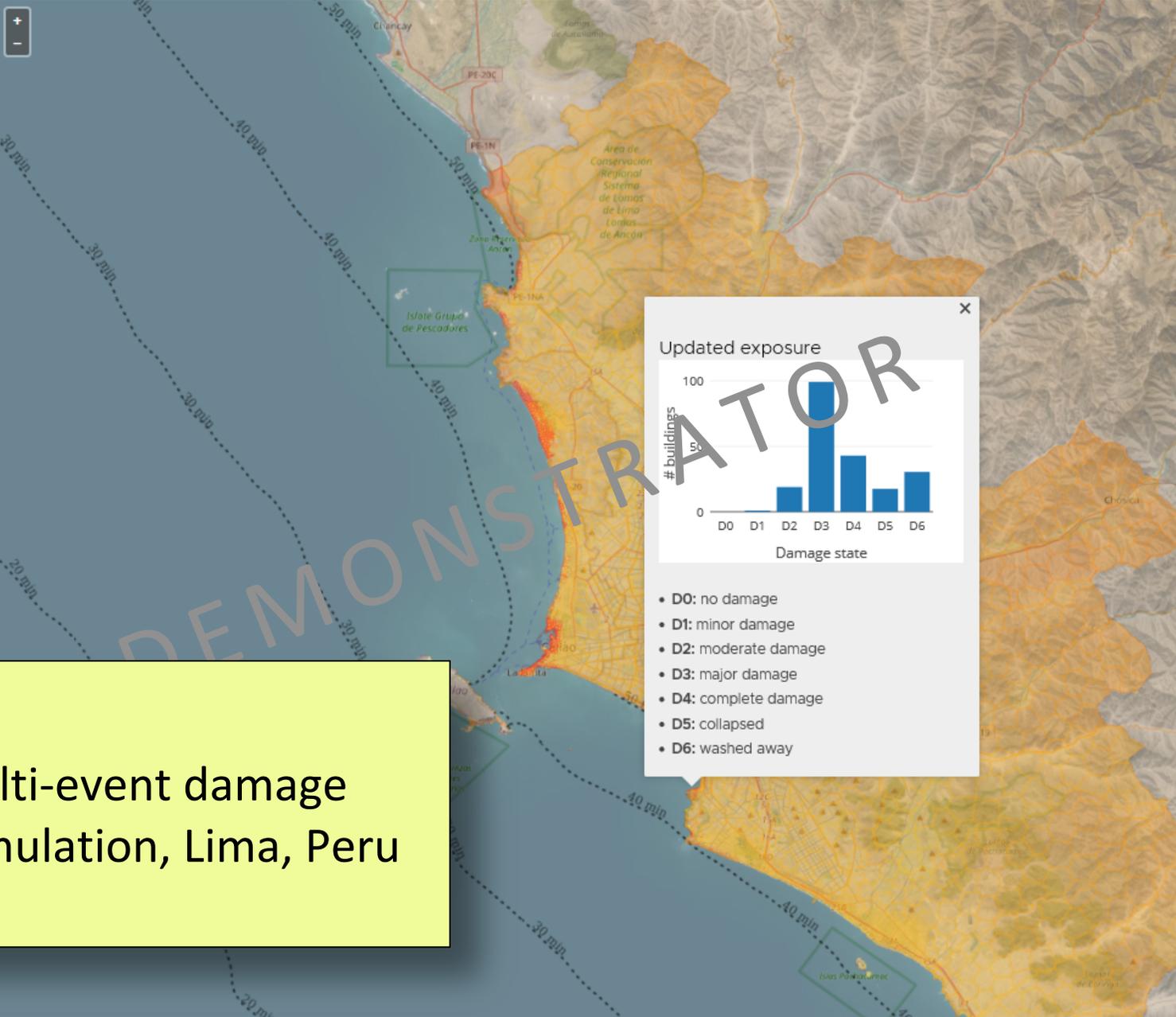
- Catálogo de terremotos Terminado
- Elija un terremoto Terminado
- Simulación de movimiento de tierra Terminado
- Modelo de exposición Terminado
- Daño post-terremoto Terminado
- Simulación de tsunami Terminado
- Daño post-tsunami Terminado

Este servicio genera información sobre los daños causados por un ...

Proveedor: Helmholtz Centre Potsdam

RECONFIGURAR

- Infraestructura – red eléctrica Terminado



Control de las capas

Resultados

- Exposición y daño por tsunami
- Daño a zonas de consumo
- Transiciones de daño por tsunami
- Pérdida por tsunami
- Tiempos de llegada
- Epicentro
- Amplitud máxima del tsunami
- Profundidad máxima de inundación - 10m
- Profundidad máxima de inundación - 10m
- Pérdida por terremoto
- Transiciones de daño por terremoto
- Exposición y daño por terremoto
- Exposición inicial
- shakemap
- Terremoto elegido
- Terremotos disponibles
- Cuadro delimitador

Capas adicionales

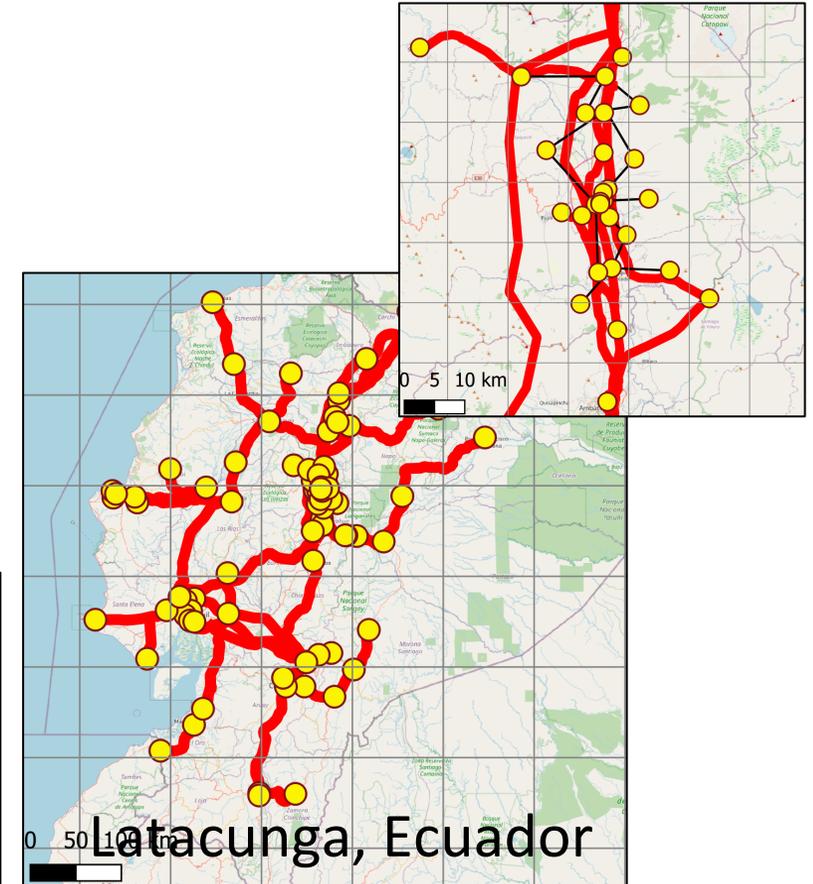
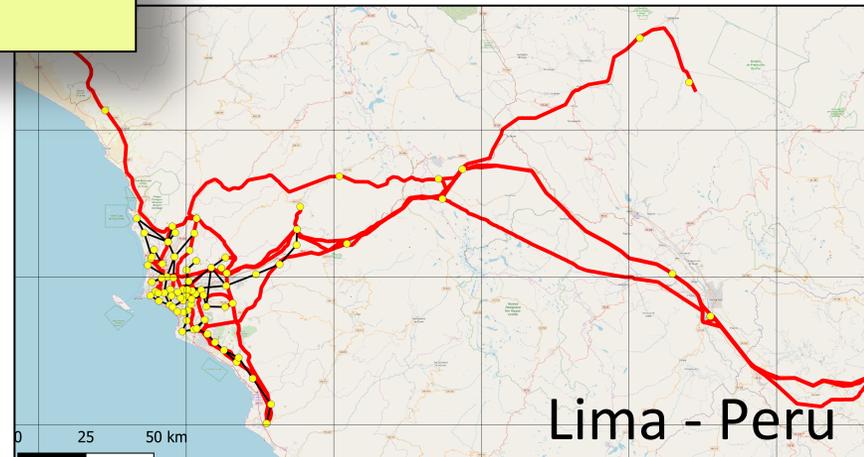
- Infraestructura electrica
- Unidades administrativas
- Sombreado
- imágenes satelitales
- OpenStreetMap

Opacidad:

Example
 Non-linear multi-event damage
 and loss accumulation, Lima, Peru

RIESGOS Demonstrator: landing page (as of May 2020)

Complex infrastructure such as power networks are simplified. Advanced approaches are used to seek for optimal trade-off between complexity and realism of the models.



Asistente de Configuración

- Selección del VEI Terminado
- Caída de ceniza Terminado
- Exposición para caída de ceniza Terminado
- Daño por ceniza Terminado
- Simulación de lahar Terminado

El servicio lahar anticipa el área inundada por lahares del ...
Wiki

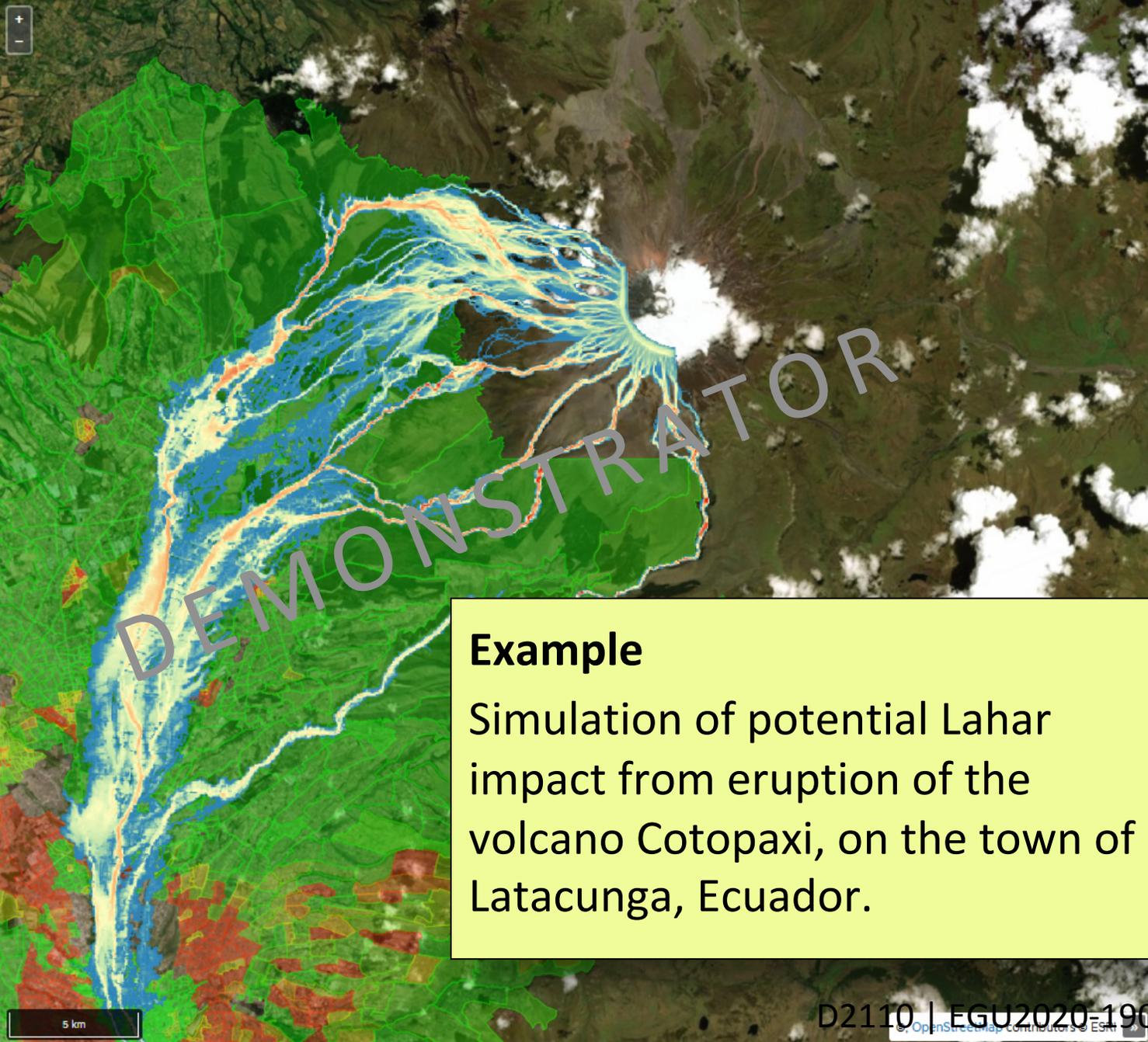
Proveedor: TUM
dirección: Sur

RECONFIGURAR

- Exposición para lahar Preparado
- Daños por lahar Downstream
- Daño por ceniza y lahar Downstream
- Infraestructura – red eléctrica Preparado
- Inundación Downstream
- Daños por inundación Downstream

Configuración

REINICIAR GUARDAR RESTAURAR



Control de las capas

Resultados

- profundidad máxima de lahar
- Alcance 300 min
- Alcance 120 min
- Alcance 60 min
- Alcance 20 min
- deposición
- erosión máxima
- presión máxima
- Exposición por ceniza
- velocidad máxima

0 m/s
5 m/s
10 m/s
15 m/s
20 m/s
25 m/s
30 m/s

- pérdida por ceniza
- exposición para ceniza
- espesor y carga de ceniza

capacidad: 0.3

Capas adicionales

- Sistema Nacional de Información
- líneas eléctricas
- ombreado
- imágenes satelitales
- OpenStreetMap

Example
Simulation of potential Lahar impact from eruption of the volcano Cotopaxi, on the town of Latacunga, Ecuador.

RIESGOS – Key facts

PARTNERS

- DLR
- GFZ
- AWI
- TUM
- 52°North
- geomer
- EOMAP
- plan + risk
- Dialogik

ASSOCIATED PARTNER

- GIZ
- Munich RE
- UNOOSA / UN-SPIDER
- UNESCO

REGION

Chile, Ecuador and Peru

TOPIC

Natural risks

FUNDING

BMBF – CLIENT II

DURATION

01/11/2017 – 30/10/2020 (3 years)



RIESGOS – Partners for Cooperation in South America

- Cooperation with **research partners** and **public authorities** in **Chile, Ecuador and Peru**

- **Universities** and **research institutions**

- **National authorities**

- **Actors of the civil society**

- **Associated organizations**



RIESGOS in EGU 2020 (Online)

Come and chat with us !

D2111 | EGU2020-18379 ★

Dynamic physical vulnerability: a Multi-risk Scenario approach from building- single- hazard fragility- models ▶

Juan Camilo Gomez- Zapata, Massimiliano Pittore, Nils Brinckmann, and Simantini Shinde

D872 | EGU2020-8671 ★ 🗨️ 🗨️

Put your models in the web - less painful ▶

Nils Brinckmann, Massimiliano Pittore, Matthias Rüster, Benjamin Proß, and Juan Camilo Gomez-Zapata

D2143 | EGU2020-19861 ★

Scenario- based multi- risk assessment on exposed buildings to volcanic cascading hazards ▶

Michael Langbein, Juan Camilo Gomez- Zapata, Theresa Frimberger, Nils Brinckmann, Roberto Torres- Corredor, Daniel Andrade, Camilo Zapata- Tapia, Massimiliano Pittore, and Elisabeth Schoepfer

D1728 | EGU2020-11719 ★

Development of multi-hazard exposure models from individual building observations for multi-risk assessment purposes ▶

Simantini Shinde, Juan Camilo Gomez- Zapata, Massimiliano Pittore, Orlando Arroyo, Yvonne Merino- Peña, Paula Aguirre, and Hernán Santa María



RIESGOS – Further Information



www.riesgos.de



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The research and development project RIESGOS (Grant No. 03G0876) is funded by the German Federal Ministry of Education and Research (BMBWF) as part of the funding programme 'CLIENT II – International Partnerships for Sustainable Innovations'.

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From single-hazard to multi-hazard risk assessment, including exposure and dynamic vulnerability, and progressing towards the analysis of cascading effects

In recent decades, the risk to society due to natural hazards has increased globally. To counteract this trend, effective risk management is necessary, for which reliable information is essential. Most existing natural hazard and risk information systems address only single components of a complex risk assessment chain, such as, for instance, focusing on specific hazards or simple loss measures. Complex interactions, such as cascading effects, are typically not considered, as well as many of the underlying sources of uncertainty. This can lead