

# Key achievements & perspectives

An interdisciplinary project UGA (GI2R)



Grenoble **Risk**  
Scientific Days

May 16th & 17th 2024

Auditorium Bâtiment IMAG - Campus UGA

[risk.univ-grenoble-alpes.fr](http://risk.univ-grenoble-alpes.fr)

# Context of risks

✓ One of the grand-challenges of our times



*Tohoku earthquake, tsunami and nuclear accident, Japan, 2011.*



*Roquebillière - La Vésubie Valley (France), before/after Alex storm, 2020.*

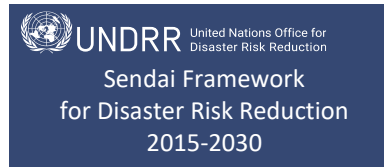
✓ A strategic priority at international to local levels

## United Nations sustainable Developments Goals



Target 11.5: "By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations".

## UNDRR/Sendai

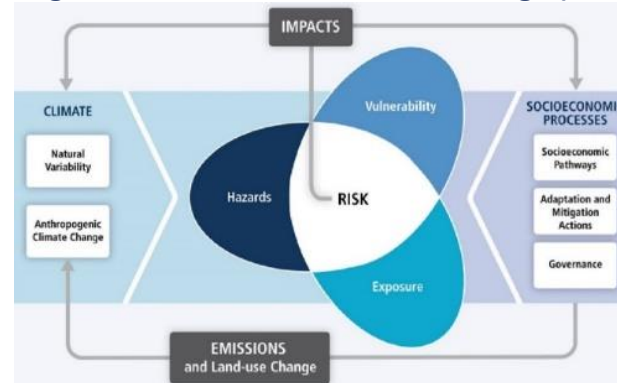


AllEnvi, french national research alliance on environmental issues

## Scientific strategy of University Grenoble Alpes (France) UGA

- Sustainable planet and societies
- Health, well-being and technology
- Understanding and supporting innovation
- Digital technology at the service of human being and society

## Intergovernment Panel on Climate Change (IPCC)





# Risk science: specific challenges

- ✓ Accounting for climate change & anthropisation: complex dynamics and evolutions
- ✓ Whole cycle of risk management
- ✓ Systemic thinking with sustainability science perspective



# Why a risk institute in Grenoble ?

✓ A *marriage of convenience*...



North face of the Grand Pic de La Meije (alt. 3983m) and the villages of La Grave, large avalanche deposit close to settlements (South Isère – Winter).



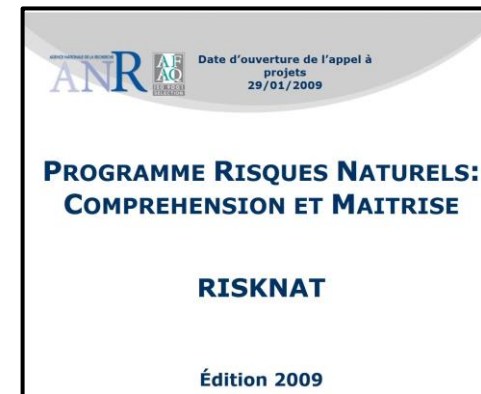
Pont de Claix chemical plants (south of Grenoble) and cliffs of the Vercors massif.



Flooding of the Alpine river Isère and Grenoble city center.

✓ And an *old paramour* !

- Excellent (disciplinary) research within labs
- Existing devoted (interface) structures (PARN, IRMa)
- A national hub for research on risk science since ~1980  
(e.g. animation of the RISKNAT project call for the National Research Agency - until 2010)



A french puzzle ...

## Geosciences

- ISTERre (solid earth)
- IGE (climate and cryosphere)
- EDYTEM (geoheritage, mountain)
- CNRM (snow)

## Human & social sciences

- LIP-PC2S (psychology)
- PACTE (sociology, geography, ergonomics)
- LARHRA (history)

## Civil engineering & architecture

- AE&CC (architecture)
- 3SR (geomechanics)

## Economy & finance

- CERAG (finances)
- CREG (economy, politics)
- GAEL (economy)

## Modeling, systems & IA

- GIPSA-lab (modeling)
- LJK (Applied math)
- LIG (computer sciences)
- INRIA (computer sciences)
- TIMC-Imag (modeling)

## Industrial innovation

- G-SCOP (management)
- LETI-CEA (innovation)
- LEGI (fluids mechanics)

➔ Dispersion of skills among several labs (details in Appendix 1) leading to silos and disciplinary approaches of natural and industrial risks.

# Building up interdisciplinary research between disciplines and laboratories

## RISK cross-disciplinary program (CDP Risk 2018-2022) – University Grenoble Alpes

First three-year IDEX projects to be funded.

➔ Most of the funding towards co-supervised theses:

- ➔ • **11 PhDs**
- Rules: **interdisciplinary, at least 2 labs**



financed by  
**IDEX Université Grenoble Alpes**

### CDP Risk PhD Themes

- **Archeoseismology** and past earthquake perception
- **Risk perception** and landslides
- **Evacuation of population** including human behavior during seismic crises
- **Physics-based dynamical model** of landslides towards Early Warning Systems
- **Physics-Informed Deterioration Modeling** and Maintenance Optimization of Torrent Protection Structures
- **Seismic vulnerability** of earth masonry
- **Towards User Interface Adaptation** to Users Emotions In a Natural Risks Programmes
- **Multi-decadal changes in glacial and periglacial systems**
- **Statistical inference for extreme risk measures**: Implications for natural disasters insurance

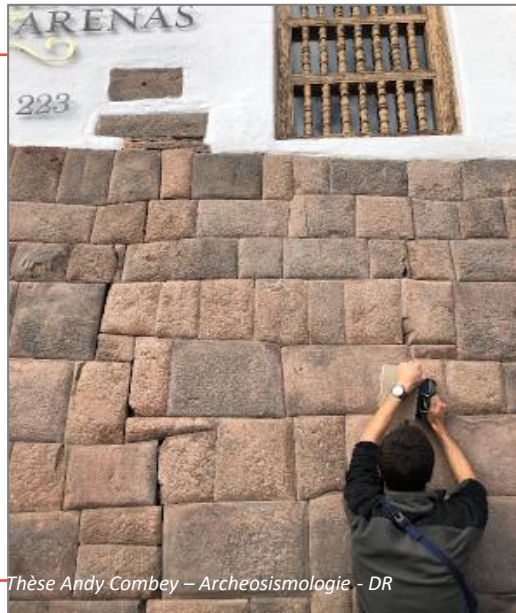


# Building up interdisciplinary research between disciplines and laboratories

## Protective structures: Inspect and repair a little and often, or wait and risk of having to carry out more costly work?

Developing **models for operational safety, decision-making and resilience** of protective structures accounting for dynamic deterioration and ageing of protective structures.  
*reliability - monitoring - civil engineering – applied probabilities and stats - decision sciences - natural risk engineering.*

**Thesis title:** *Deterioration modelling and performance assessment of protection systems/structures against natural risks: application to monitoring and preventive maintenance of torrent check dams, Nour Chahrouh (INRAE)*  
Supervisors : Christophe Berenguer (GIPSA-Lab) & Jean-Marc Tacnet (INRAE)



## How archeoseismology on Inca's monuments can help bridging the gap between paleoseismology, historical earthquakes and population's risk perception ?

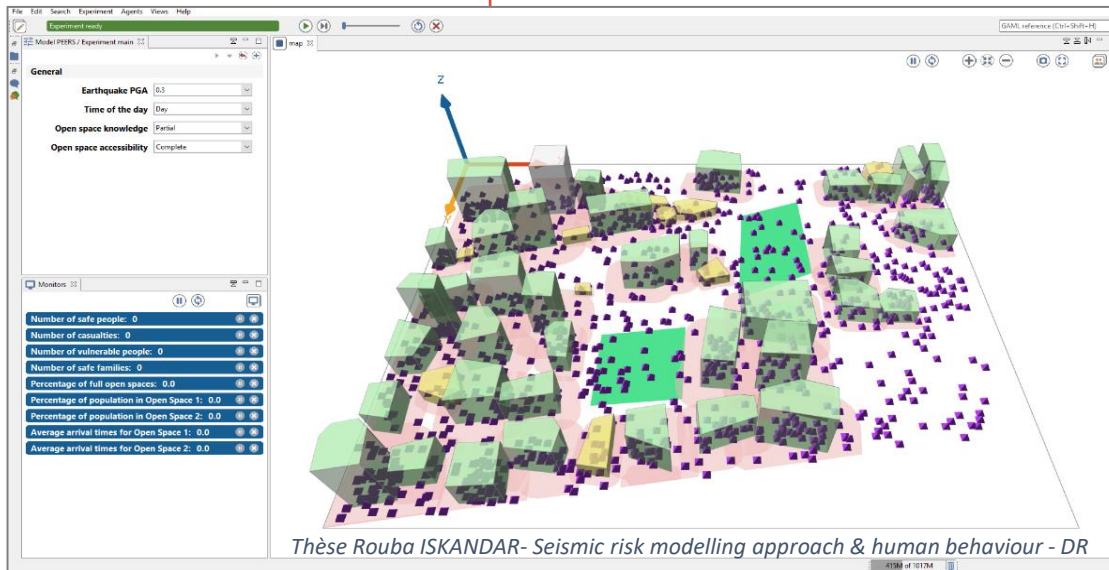
Developing **transdisciplinary methodology** at the interface between seismology, archeology, geomorphology, oral history (tales), risk perception.



### UGA interdisciplinary thesis prize in 2023

**Thesis title:** *Archeoseismology by the joint approaches of Seismic hazards and Risk Estimation, Prehistorical sites in seismic settings and Architectural Resilience of archeological remains, Andy Combey (ISterre) ; Supervisors : Laurence Audin (ISterre) & David Gandreau (AE&CC)*

# Building up interdisciplinary research between disciplines and laboratories



*Thesis title: An integrated seismic risk modelling approach including human behaviour*

Rouba Iskandar (ISTerre).

Supervisors : Elise Beck (PACTE), Cécile Cornou (ISTerre) & Julie Dugdale (LIG)

**Does the human behavior and mobility really need to be included in seismic risk models ?**

Development of a **multi-agent model** taking into account both the **physical environment** (damages, debris) and **human reactions** to simulate population evacuation in the event of an earthquake.

*Seismology, civil engineering, geography, computer sciences*



**Best student poster**

10th conference of the international society for Integrated Disaster Risk Management (IDRiM2019)



Phase 2 (2022-2025)

# Implementation of a Risk Institute

---

# Implementation of a Risk Institute

## Goals



Build a multidisciplinary research institute to facilitate collective work on anticipation and resilience to natural, NaTech and health risks, in a context of anthropization and accelerated global change (climatic, environmental, societal).

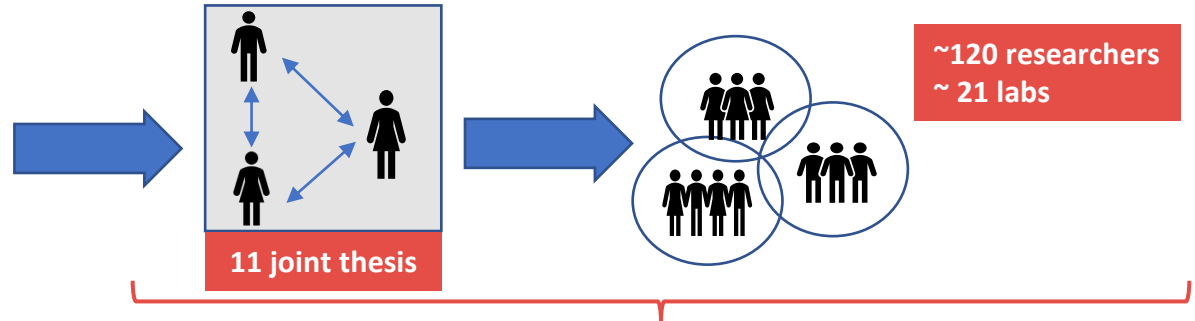
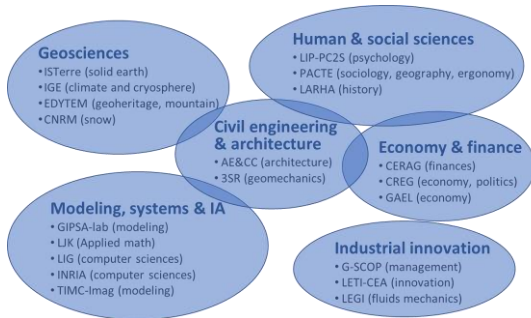
*Fundings : Cross-disciplinary project call from Université Grenoble Alpes (€ 350K – 2022/2025)*



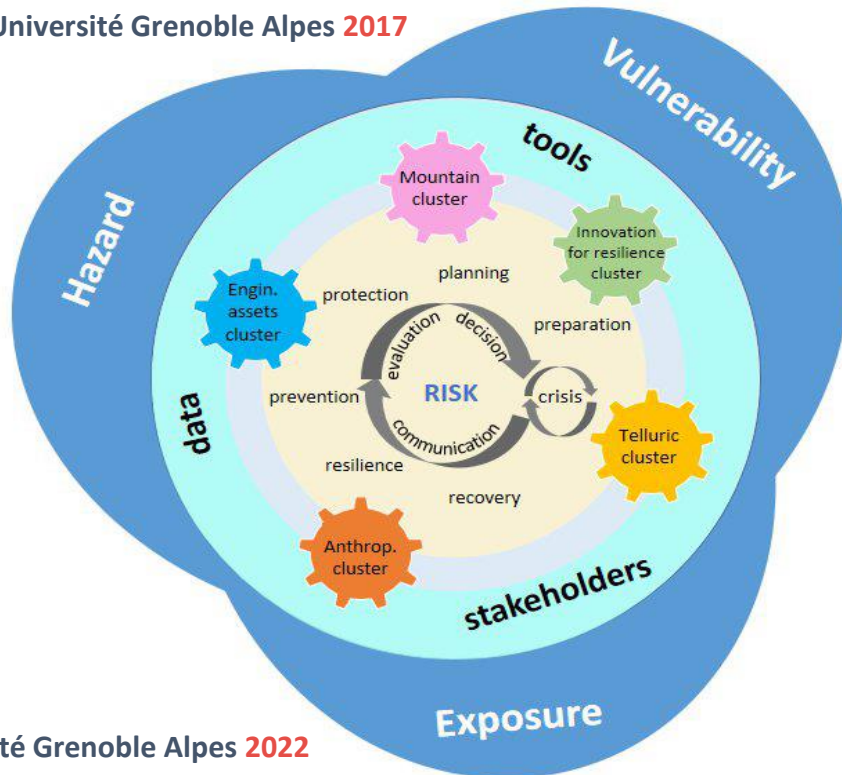
- **Bring UGA at a top-seed position in risk science at different levels:**
  - **Local** (involving stakeholders and existing research structures)
  - **National leader** (e.g. within IRIMA, national referent for various risks)
  - **International** (world-class institute such as Tsukuba and ETHZ partners)
- **Some key foreseen outreaches of the Risk institute:**
  - **Research:** 30 papers/year promoting interdisciplinary, white papers on new topics (*e.g. health crisis and risk management*), dissemination of knowledge, co-funding from large national and European projects (*3/years*).
  - **Education:** Internationalization of existing summer school, MOOC on natural hazards, role of citizen and stakeholders in crisis managements.
  - **Animation/enhancement for stakeholders:** general seminar and 2 targeted workshops / year, 5 national/international symposia, new innovation projects in connection with private stakeholders, new/consolidated databases (citizen, partner laboratories, public institution, company) and simulation platforms, Cifre PhDs.

# Construction of 5 interdisciplinary research “clusters” (1)

## French puzzle



Risk @Université Grenoble Alpes 2017



Project CDP RISK (2018-2021)

Risk @University Grenoble Alpes 2019



Project Risk Institute (2022-2025)

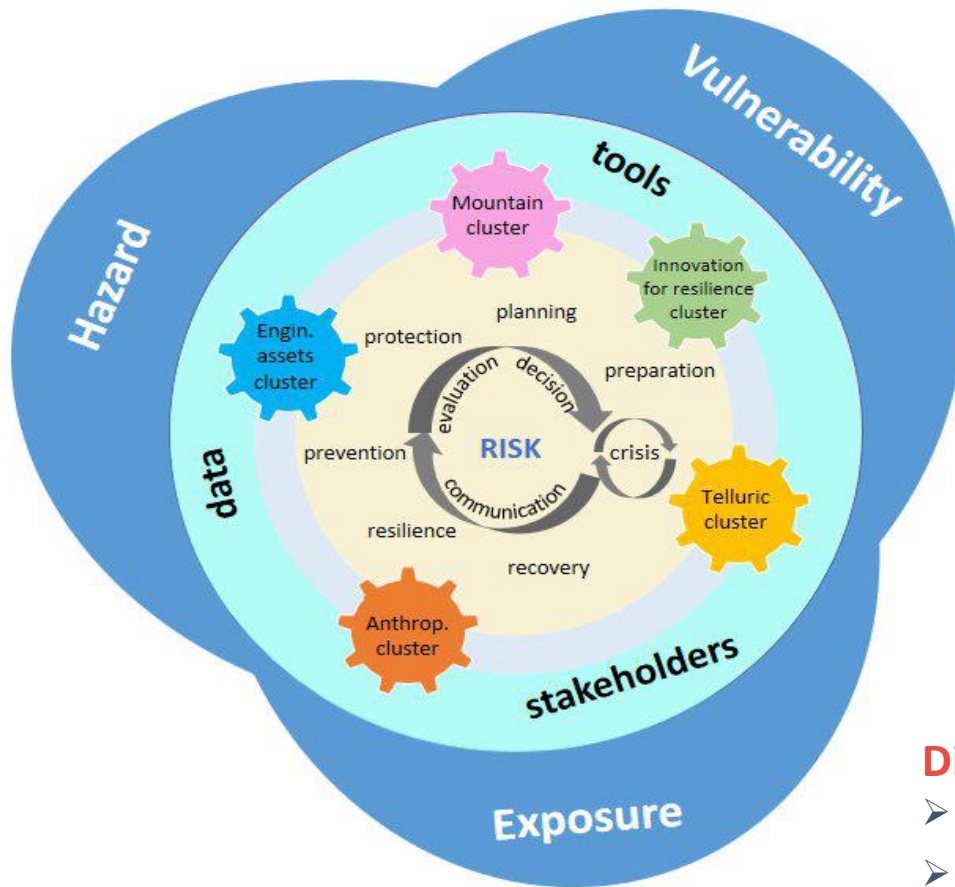
## 5 research clusters

### In each cluster:

- ✓ Human & social sciences, Geosciences and Engineering sciences.
- ✓ Research, education and relation to socio-economic partners, *details and key achievements below*



# Construction of 5 interdisciplinary research “clusters” (2)



## Transversal challenges for all clusters:

- New **non-stationary risk measures** coping for socio-environmental **changes/risk projections at different temporal horizons:**
- Combining **qualitative and quantitative approaches** within risk assessment
- Experimenting with **participatory mechanisms/action research** conducted **with the territories**
- Develop **data, modelling and simulation platforms** to anticipate events
- Improve links between risk assessment and **health and crisis management**

## Diversity within clusters:

- **Diverse operating modes**
- From **projects** already existing to construction of **brand-new projects**, especially **on emerging scientific interdisciplinary topics**

# Formal organization (where we are now)

## Risk Institute governance

- **Three co-leaders:**
  - Sandrine CAROLY (PACTE/INP)
  - Cécile CORNOU (ISTerre/IRD)
  - Nicolas ECKERT (IGE/INRAE)
- A **Management committee** gathered every 2 months with the PI of the 5 research clusters
- A **Scientific Committee** (International Advisory Board)
- A **Steering Committee** gathered when needed
- **5 thematic working groups** gathered when needed
- Each cluster has its **own budget and operating autonomy** (internal management)
- Two cross-functional resource posts : **project manager** and **engineer in geomatics**.



## ■ Institute-wide seminars/scientific events



**Seminar Series Seismic Theme - Risk Institute & 3SR**  
**Sandra Cecilia Santa Cruz Hidalgo**  
(PUCP, Peru)

**#2 Interdisciplinary project on the evaluation of the vulnerability of hospital and college of Lima (Peru)**

**Thursday, October 27<sup>th</sup>, 2022 - 4.00pm**  
ROOM 011 - Bâtiment Galilée - Laboratoire 3SR  
Campus - Université Grenoble Alpes



*Risk seminars with invited searchers.*



**RISK SUMMER SCHOOL**  
**Simulation, Resilience, & Crisis management**

**August 30 to September 1<sup>st</sup>, 2023**  
Polytech & GreEN-ER Building  
Grenoble, France

Seminar open to all upon registration  
Program & registration on [risk.univ-grenoble-alpes.fr](http://risk.univ-grenoble-alpes.fr)




**Research partnership seminar with Tsukuba University (Japan)**

- Risk Webinar Tsukuba Grenoble #1 Territories and risk – Pedestrian behaviour
- Webinar Tsukuba University & UGA #2 Critical Infrastructures at Risk
- Webinar Tsukuba University & UGA #3 Risk communication

**Séminaire/Webinaire Séisme**  
**De Bam (Iran - 2003) à Kahramanmaraş (Turquie - 2023).**  
**Quelles leçons pour le futur ?**  
Un témoignage de Philippe Garnier (AE&CC-CRATERre, ENSAG-UGA)  
Vendredi 24 mars 2023 - 14h30




**Risk Institute**  
Université Grenoble Alpes





*Risk seminars with socio-economic partners.*

**Risk Institute**  
Université Grenoble Alpes


**Journée partenaires**  
**Anticiper les risques : Technologies et nouveaux outils**

**Vendredi 29 septembre 2023**  
9h00 - 17h00  
Amphithéâtre MaCI  
Campus de l'Université Grenoble Alpes



[risk.univ-grenoble-alpes.fr](http://risk.univ-grenoble-alpes.fr)




*Annual Risk seminars in risk management towards french partners (public stakeholders, engineering office, etc.).*



**筑波大学**  
**University of Tsukuba**

**Université Grenoble Alpes**  
**Risk Institute**  
Université Grenoble Alpes

## ■ Cluster's scientific events

**Innovations for Resilience cluster, cycle 2 (extract):**

**Programme du cycle 2023-2024**

**6 décembre 2023 (14h-17h)**

**How do new technologies in citizens' hand challenge risk and vulnerability management ?**

Atelier d'ouverture avec l'Université de Swansea.

Lieu : MaCI, Université Grenoble Alpes, France + Online

Nous accueillons une délégation de chercheurs du Centre of Digital Arts and Humanities de l'Université de Swansea, tous universitaires travaillant dans le domaine des nouvelles technologies de communication pour la réduction des risques et des vulnérabilités.

[+ Programme et inscription](#)

**12 février 2024 (12h15 - 14h00)**

**Citizen Science: How Citizens Engage in Digital Ways of knowing.**

Bernhard Wieser (TU, Graz, Austria)

Lieu : MaCI, Université Grenoble Alpes, France + Online

Bernhard Wieser est chercheur en philosophie des sciences à l'Institut des systèmes interactifs et de la science des données de l'Université technique de Graz (Autriche). En tant que chercheur en STS, il a étudié les aspects éthiques, juridiques et sociaux de la recherche sur le génome et leur application dans les diagnostics génétiques. Plus récemment, il a dirigé un projet de recherche sur la science citoyenne dans le domaine de la pollution de l'air.

[+ Programme et inscription](#)

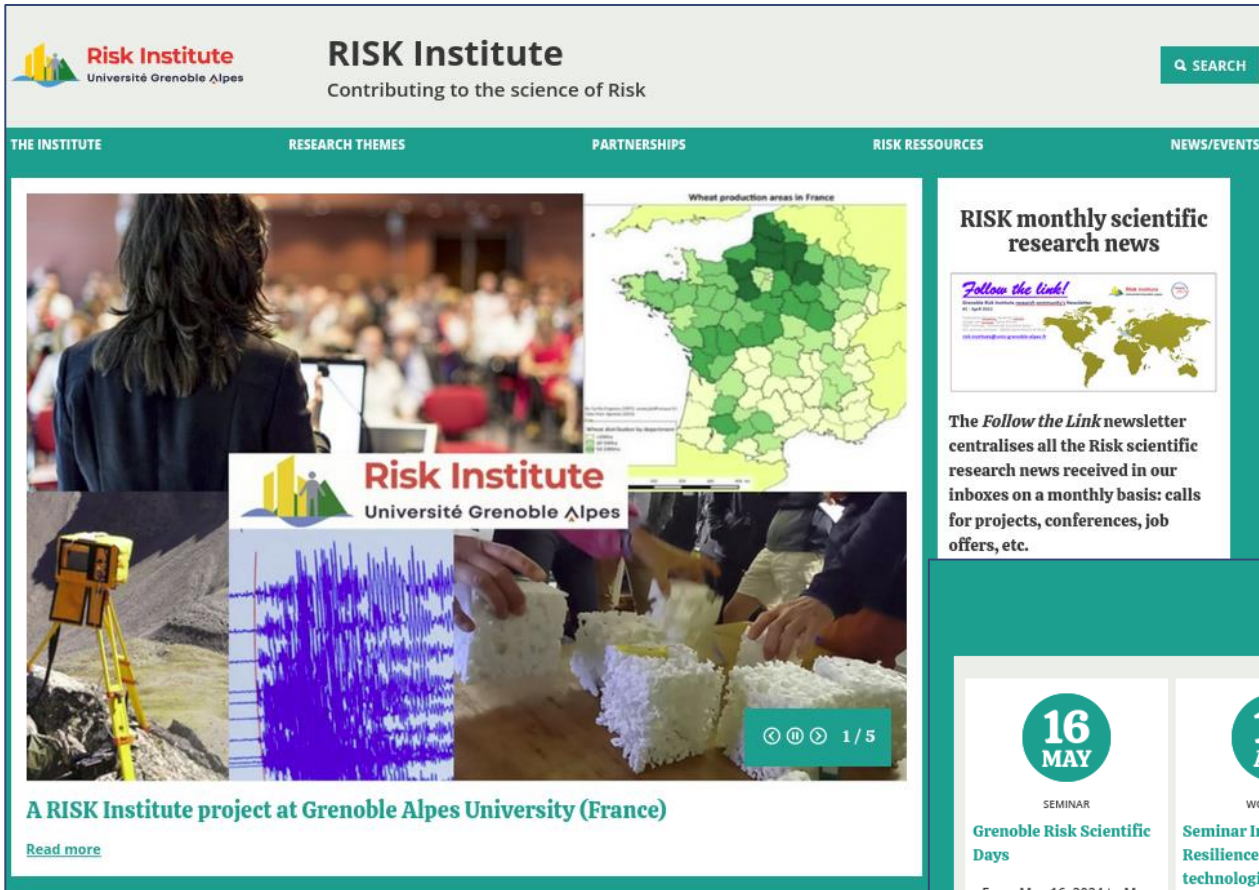
**15 Avril 2024 (11h00 - 12h45)**

**Digital technologies in biodiversity citizen science: how they shape knowledge production and codify participation**

Debbie Gonzales Canada (University of Melbourne, Australia)

Lieu : MaCI, Université Grenoble Alpes, France + Online





[risk.univ-grenoble-alpes.fr](http://risk.univ-grenoble-alpes.fr)

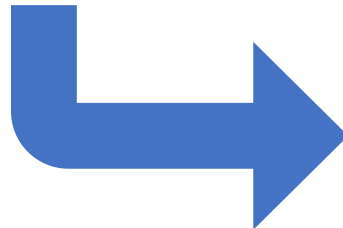
Construction of a new website dedicated to the communication of the Risk Institute project :

- News and events
- Presentation of the project
- Presentation of the thematic clusters and contacts
- Building partnerships
- Risk resources available

A RISK Institute project at Grenoble Alpes University (France)

[Read more](#)

This website is the central tool for organizing our Risk events: contact, program, registration forms, replay, etc.



### Risk Events in Grenoble

<p><b>16</b> MAY</p> <p>SEMINAR</p> <p><b>Grenoble Risk Scientific Days</b></p> <p>From May 16, 2024 to May 17, 2024 Saint-Martin-d'Hères - Domaine universitaire</p>	<p><b>15</b> APR</p> <p>WORKSHOP</p> <p><b>Seminar Innovation for Resilience - Digital technologies in biodiversity citizen science: how they shape knowledge production and codify participation</b></p> <p>On April 15, 2024</p>	<p><b>18</b> MAR</p> <p>WORKSHOP</p> <p><b>Webinar Tsukuba University &amp; UGA #3 - Risk communication</b></p> <p>On March 18, 2024 Saint-Martin-d'Hères - Domaine universitaire</p>	<p><b>12</b> FEB</p> <p>SÉMINAIRE</p> <p><b>Séminaire Innovation for Resilience - Citizen Science: How Citizens Engage in Digital Ways of knowing.</b></p> <p>On February 12, 2024 Saint-Martin-d'Hères - Domaine universitaire</p>
---	--	---	---

[View all Risk Institute events](#)

## RISK Ressources

Print

Here you'll find Risk research information produced or shared within the Risk Institute: replay of our summer schools and workshops, webinar materials, newsletters, theses, publications... and our expertise and animation tools.

- [Newsletters](#)
- [Publications](#)
- [Replay \(workshops, webinars\)](#)
- [Webinars material](#)
- [Thesis](#)
- Outils animation et expertise

**ATELIER**  
**Workshop Cycle « Innovations for Resilience » - #10 closure session**

Le 3 juillet 2023  
Saint-Martin-d'Hères - Domaine universitaire

Putting innovation back into society : what's the plan ?

[En savoir plus](#)

**ATELIER, CONFÉRENCE**  
**Workshop Cycle « Innovations for Resilience » - #9 June session**

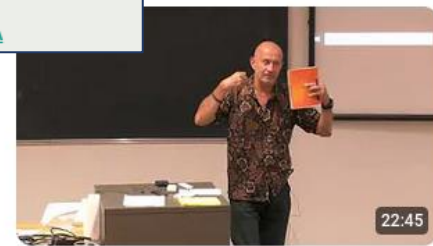
Le 12 juin 2023

"Thermalism, vulnerability and territories - The evolution of the municipal government of thermalism and its implications on the offer and the image of the thermal towns"

**RISK@UGA YouTube Channel**  
[Utube RISK@UGA](#)



Summer School RISK 2022 - UGA - Earthquake & social media - D. CONTRERA...



Summer School RISK 2022 - UGA - Citizen involvement in crisis management - F...



cdp-Risk Experimentation Sismique des constructions en Adobe (L3SR univ Grenob...



Aurelie Peillon - Avalanche exercise, full-scale simulation

- **Free replay and materials** from the risk presentations given, in compliance with the French RGPD with authorisation forms for capturing services, accessible to allhosted on a YouTube Risk @UGA channel.
- **Content to be migrated on an internal platform** at Université Grenoble Alpes.
- **In the long term, will host publications of affiliated researchers.**

## A mature RISK Institute network

- Several thematic mailing lists:
  - A general list - 617 subscribers (Research & economic partners)
  - 5 thematic scientific mailing lists (by cluster)
  - 1 scientific mailing list for affiliated RISK researchers – 230 subscribers
- RISK information relay for 6 years: newsletters and dedicated website in French & English.
- Newsletters *Follow the Link*: monthly summary of Risk news in our e-mail inboxes (funding, jobs/jobs, publications, conferences, etc.) for Risk Institute affiliated researchers.



## Animation of the research ecosystem

- Coordination of responses to research calls for projects
- Facilitating contacts with external scientific and economic partners
- Disseminating research results
- Dissemination of wider relevant information

### To be developed...

- Publication of **Risk@UGA collective content** (thematic works, reviews, conferences, etc.).
- **HAL: Risk@UGA publications referenced with a RISK numeric stamp.**
- **Launch of calls for projects** (Impulsion, support for events, etc.)
- **Risk data center for the results of Risk research** in Grenoble in connection with current local projects
- **Partnership agreements**



# Risk teaching and education

## Graduate School@UGA:

Initial education pillar at master's level (2021-)  
16 thematic programmes towards PhD

➔ **RISK thematic program of the Graduate School**  
Technological, natural and financial risks, critical infrastructures, crisis management, risk prevention

Examples of tutored research projects proposed in the university laboratories within the program:

- ✓ Risk perception of permafrost warming relevance
- ✓ Comparative analysis of value and insurance in a context of natural hazards: application to the field of farm production and exposed infrastructure
- ✓ Characterization of nature and influence of information imperfection in decision processes: an experimental survey process related to natural risks management
- ✓ Financial and human impact of 2010 Eyjafjallajökull eruption
- ✓ Decision making tools in seismic risk and post-disaster reconstruction fields
- ✓ Tracking population flow during earthquake crisis with seismological methods



$$|\phi - \phi_0|^2 + \frac{\sigma}{2} \sum_{i=1}^N \left( \int_{t_0}^t \delta_A(t - t_k) v(t) dt - v_{max}(t_k) \right)^2$$

**Enquête**

2020/2021  
**Graduate Program Risk**  
UGA Université Grenoble Alpes

**Integration event**  
One day introductory seminar to acquire a common vocabulary on risks (hazard, vulnerability, resilience, decision tree, etc.) and common tools and methods followed by a role play on risks. This seminar will focus on natural, financial and industrial risks. Two days of site visits will complete this introductory seminar (e.g. Harmallière's landslide, trading room, vibration table, avalanche simulations, etc.).

**First year (M1, 6 credits)**  
**RISK mentored research project**  
The goal is to offer students a research experience on modeling, analysis, evaluation or decision making in the field of risks. The projects will be carried out by student pairs with complementary skills, supervised within the laboratory by a researcher in charge of the mentored project.

**Second year (M2, 6 credits)**  
**RISK Summer School**  
The summer school aims to provide solid knowledge on risks (cascading effects, crisis simulation, resilience/governance or decision support) by capitalizing on the achievements of past summer schools and presentation of new topics. This summer school will be held over 3 days: 2 days of lectures, 1/2 day of exercises and 1/2 day of site visits. This teaching will also include a personal work aiming to provide a feedback on the contents of the summer school and to prepare in binomial a report on an accident related to a major natural or industrial risk.

**More information**  
Cross-Disciplinary Thematic Program in Risk M1 & M2  
carnou@univ-grenoble-alpes.fr

Displacement  
Rate  
0 1000  
White AOC price

# Links with socio-economic partners

**Who ? Municipalities, science-society interface associations, regions, engineering firms, companies of energy, transport or chemical plant, NGOs, etc.**

- **1 workshop of socio-economic partners in 2022:** gathering their:
  - . **expectations** from the Risk Institute (recent research, participation in study days)
  - . **contributions** (access to the research field, bringing up social demands).
- **1 seminar of partners and researchers in 2023:** “Risk anticipation: technologies and new tools”.
- **Participation of our partners PARN & IRMA** (science-society interface structures) to the 2023 Risk Summer School: **serious game and simulation of crisis** for students, economic partners and researchers.
- Co-design of **2 serious games** with the PARN for **socio-economic partners** and **students**:
  - . **Gescocrise Cascading** (landslide and long crisis)
  - . **Gescocrise Healthcare** (domino effect on healthcare system).



# Incubation of research projects to generate funding

- ✓ **No large direct funding:** active search for co-funding “everywhere”
- ✓ **Clusters and institute as a whole:**
  - An incubator for innovative projects
  - An efficient and reactive network
- ✓ **>10 M€** obtained since beginning of phase 2 at local, national and international levels, and from public and private funders.
- ✓ **France 2030: a specific opportunity (cf. Appendix 2)**
  - ~20 large (~50M€ budget) 10-year programs called “PEPRs” on crucial challenges
  - Presence of the risk institute in different PEPRs related to risks but also forests, sustainable cities, applications of maths, etc.
- ✓ **IRIMA - Risk PEPR: a strong relation with our institute and a key opportunity**
  - PEPR co-lead by UGA
  - Organization largely inspired by our clusters
  - People from risk institute at key positions
  - >4M€ already acquired, still to be completed





# Quantitative summary

## since the beginning of phase 2

Scientific ambitions of Risk Institute	Delivrables/results
Responding to calls for research projects	<p>National projects:</p> <ul style="list-style-type: none"> <li>• &gt;4 M€ (IRIMA),</li> <li>• 1,2 M€ (other projects from French national research agency),</li> </ul> <p>International projects: K€ 650            Industrial projects: K€ 793            Local public institutions: M€ 3,5            National public institutions (technical ministries): M€ 1,4</p>
Scientific production	97 publications, 5 books/chapters
International scientific relations	<p>3 days+ 2 days of Swansea University delegation            1 day of Iraki delegation            1 visit Québec (Univ. Laval, Sherbrooke, univ. Montreal)            1 visit Switzerland (HES-SO meeting)            4 Webinars with Tsukuba University</p>
Interface with socio-economical partners	<p>1 day seminar in 2022 (56 people)            1 day seminar in 2023 (80 people)            1 summer school co-organized with partners</p>
Training Graduate school risk	<p>2 international summer schools (60 people)            3 field trips days during summer school (one per summer school)</p>

*See details in Appendixes provided!*

# Mountain Risks in the context of global change

## Risques en montagne et changement global

### Coordinators:

**Guillaume CHAMBON** (IGE / INRAE, *geomechanics*)

**Florie GIACONA** (IGE / INRAE, *geohistory*)

**Pascal HAGENMULLER** (CEN / CNRM, *snow and climate sciences*)

### Objectives and expected results

- ❖ *Understand and help manage risks specific to sensitive mountain territories, with a focus on long-term anticipation and planning:*
  - *risks related to extreme meteorological events, cryosphere evolution, cascading processes, etc.*
- ❖ *Characterize the different components of risks (hazard, vulnerability, exposure) and their evolution trajectories in the context of global change*
- ❖ *Optimize risk mitigation and protection strategies taking account of technical and socio-economic constraints*

### Methodology and tools

- ❖ *Integrated approach: from the characterization of physical and socio-environmental processes to the evaluation and minimization of risks*
- ❖ *Coupling climatic / socio-environmental projections with statistical / process-based models of hazards, vulnerability and risks*
- ❖ *Wide panel of methods: statistical and numerical modelling, field and laboratory experiments, observatories, databases, cartography, archives, discourse analysis, etc.*

### Multidisciplinary

- ❖ *geosciences, geomechanics, civil engineering, hydro-climatology, probability and statistics, decision sciences, geohistory, sociology, economy*

### Partnership

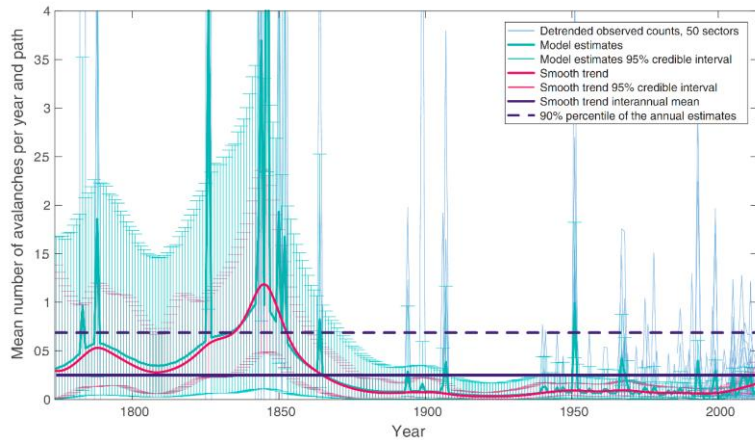
- ❖ *Scientific partners (UGA): IGE, ISTerre, 3SR, LEGI, CNRM/CEN, LARHRA, LJK-INRIA, GIPSA-Lab, LESSEM, GAEL*
- ❖ *Local and regional stakeholders, state services, associations, natural parks, etc.*
- ❖ *Private companies: natural hazards consulting & engineering, mountain industries, transportation, etc.*

### Areas

- ❖ *Mainly European Alps, projects also in the Pyrénées, Vosges, Himalayas, etc.*



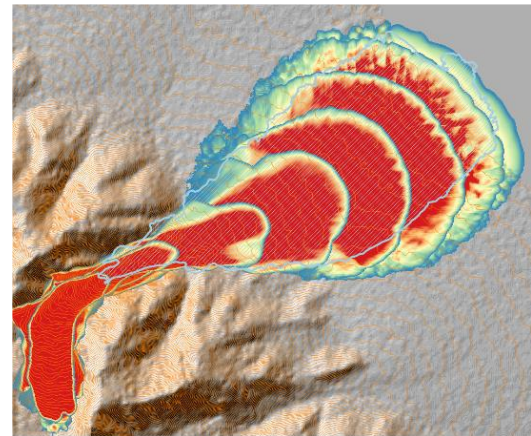
- A few illustrative results**



**Reconstruction of avalanche activity in the Vosges mountains from 1774 to 2013 combining geohistorical documentation and Bayesian modelling (Giacona et al., PNAS, 2021)**



**Multi-method analysis of channel change during catastrophic Alex storm (Piton et al., Geomorphology, 2024)**



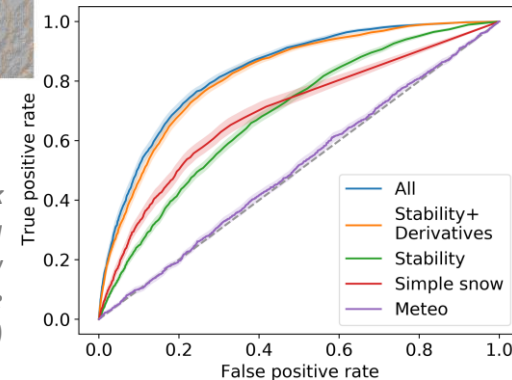
**Back-analysis of a massive ice avalanche (Aru, Tibet, 2016) through numerical modelling (Faug. et al., Rapport DGPR, 2023)**

23



**Holistic rockfall risk assessment in high mountain areas affected by seismic activity (Farvacque et al., Risk Anal., 2023)**

**Combining modelled snowpack stability with machine learning to predict avalanche activity (Viallon-Galinier et al., The Cryosphere, 2023)**





### • Examples of ongoing structuring projects:

- ❖ **GRANIER: Gravitational hazards in the context of risks prediction - Nonsmooth modeling and simulation with data**  
Action expo. INRIA → *development of advanced mechanical modelling tools*
- ❖ **MECASNOW: Innovative platform for the mechanical characterization of snow and snow-structures interactions**  
CPER Project → *structuring of the community around state-of-the-art experimental facilities*
- ❖ **PAPROG: Action Plan for the Prevention of Glacial and Periglacial Risks**  
French Environ. Ministry → *operational transfer of research results in response to societal demand*
- ❖ **PrévRisk-CC: Risk Prevention and Adaptation to Climate Change in the Espace Mont-Blanc Territories**  
INTERREG-ALCOTRA → *operational monitoring of emerging risks, awareness and information actions*
- ❖ **Geo3ilab: Joint laboratory for the development of innovative monitoring and warning technologies for natural hazards**  
ANR Labcom → *reinforced partnership between academic sector and a private company*
- ❖ **C2ROP2: Rockfalls, risks and protective structures**  
National project → *federative action-research initiative bringing together academic and socio-economic actors*



### • Ambitions and perspectives

- ❖ **PEPR IRIMA / IRIMONT (+ joint actions with PEPR FORESTS, MathVives): numerous multidisciplinary projects about to start**
  - *data integration and dynamic risk mapping*
  - *data / model coupling for early-warning systems*
  - *benchmark of numerical models for gravitational flows, development of advanced fragmentation models for permafrost*
  - *multi-source reconstruction of past relations between hazards and climate, long-term chronologies*
  - *building of risk-related knowledge in mountain territories*
  - *snow loading on protection structures in the context of climate change*
  - *collective perception and management of risks related to permafrost degradation*
  - *etc*

- ❖ **Continue to foster collaborations among Grenoble mountain risk ecosystem: development of new research and innovation actions**
- ❖ **Scientific and technical animations, in collaboration with other existing structures: seminars, scientific days, dissemination and transfer**
- ❖ **Life-long education: development of an offer in the domain of mountain risks**

# Engineered assets at risk

*Infrastructures, structures, systèmes et risques*

### Coordinators :

**Julien BAROTH** (3SR, Reliability, (Geo)mechanics, Civil Engrg)

Christophe **BERENQUER** (GIPSA, Reliability & Maintenance, monitoring, stochastic modelling)

**Geffroy ENJOLRAS** (CERAG, Management science, finance, insurance)

**Jean-Marc TACNET** (INRAE, Civil Eng., Soil mechanics, Inform. science, decision making)

### Methodological challenges and expected results: **From information to expertise and modelling**

- i) Develop and show how generic approaches can be implemented for quantitative risk modelling and assessment for natural, technological, financial exposed assets as parts of complex, interdependent systems, under dynamic cascading interactions within the context of global change;
- ii) Producing innovative integrated & generic quantitative decision-making methodologies under risk and uncertainty for infrastructures and systems management

### Multidisciplinarity: **Safety and reliability analysis, Decision sciences, Civil engineering, Economy**

- Past and ongoing PhDs co supervised by complementary laboratories (co-directed works) ;
- Research interdisciplinary group on Reliability (FIMA)

### Partnership: **From academic to industrial and operational collaborations in:**

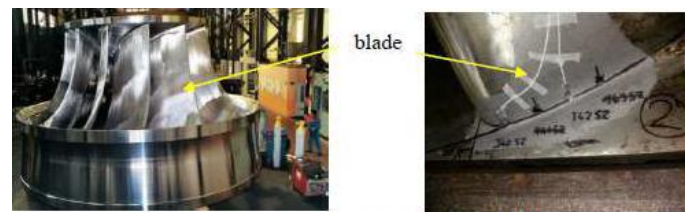
- Focused projects (PC) Natural & technological risks & Montagne of the national PEPR Risk program IRIMA (3 PhDs)
- Medelia industrial chair (Grenoble INP Foundation).
- Partnership with the European Safety Reliability Data Association: ESREDA
- Labex TEC21 & PERSYVAL-lab
- French institute for risk Management (IMdR: *Institut pour la maîtrise des risques*)

## Example of scientific cluster projects: European project group (ESReDA)

# Resilience Assessment of Critical Infrastructures

### ■ Past, ongoing, future multidisciplinary PhDs tackle this issue

- Hydromechanical structures under fatigue: turbines, lock gates,...
- Dynamic vulnerability assessment
- Complex systems and cascading effects assessment
- Spatial group decision-making
  
- Leading a European project group (ESReDA, 2023-)
- Producing scientific publications (PhDs, articles,...)
- Helping operators to take decisions  
(collaboration with industrial partners et public bodies)



Turbine (EdF & GE, 2018, in Savin et al. 2021)



Lock gate (USACE, 2002)

### ■ Perspectives

**Fostering interdisciplinarity** thanks to cross-cutting applications in partnership with end-users (public, private, links with other clusters) for different systems & assets, multi-risks

➤ *Call for proposals in preparation: 12k€ to be shared in selected interdisciplinary projects*

### ■ Links with Thematic Program « RISK » of UGA Graduate School

- Contribution to pluridisciplinary mentored projects (subjects, mentoring)
- Contribution to the thematic Risk summer school
- L3/M1/M2 research projects in the labs
- PhD offers (funded e.g. under the CIFRE framework)



### Coordinators:

**Laurence AUDIN** (ISterre, archaeoseismology and natural hazards, past resilience issues)

**Philippe GARNIER** (AE&CC, architecture, human settlements, DRR, cultural heritage and archaeology)

**Yannick SIEFFERT** (3SR, civil engineering, modelling and experimental)

### Objectifs and expected results

- ❖ Identify, characterize and document impacts (material and immaterial) and adaptation strategies in areas prone to natural hazards related to built environment and human settlements issues with a specific focus on past and current disadvantaged communities
- ❖ Co-evaluate potential socio-technical options, develop modelling, prototypes and reengineering/retro-engineering for today's challenges related to DRR and Climate Change Adaptation

### Methodology and tools

- ❖ Archaeoseismology and local building cultures multiscale approach
- ❖ Coupling modelling and experimental
- ❖ Contributive and collaborative research and research by/through projects
- ❖ Territorial assessment and iterative approach

### Multidisciplinarity

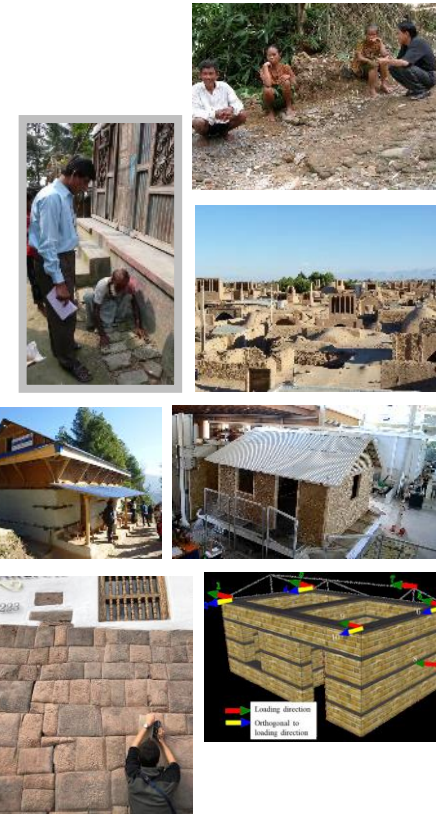
- ❖ Archeology, Architecture, Civil Engineering, Geography, Geomorphology, Sociology, Territory Science

### Partnership

- ❖ Scientific partners: within UGA through the next LabEx consortium "UG@rchitecture" (13 labs) and outside: university of Oxford, UCL, Oxford Brookes, PUCP, University of Yazd, UNESCO Chair network (41 institutions), etc. through programs (e.g. EPOS) or MoUs
- ❖ UN system (UNESCO, UN-Habitat, UNDRR, UNEP, IOM, etc.) and civil society organisations in the Humanitarian and Development NGO sector (IFRC, Caritas, AFPCNT, AFPS, etc.)

### Areas

- ❖ "Global": Haiti, Nepal, Peru and South America, Iran and Central Asia, Subsaharian Africa, Mediterranean area, France and Europe



### On-going structuring and emblematic projects:

- ✓ **EWAP « Tamang Himalayan Architecture » project**  
Documenting and safeguarding local building cultures using architectural conventional and digital survey
- ✓ **ARCHEOSISMO** (Continuation of the research developed in Peru as part of the CDP Risk)  
Strategic partnership with the University of Oxford encompassing archaeology, seismology, architecture and civil eng. to establish the research pathway for the future and common research project in Central Asia Cultural Heritages sites
- ✓ **Local building cultures and post-disaster reconstruction**  
Contribution to decision making process in reconstruction programme through self-recovery approach at global level and scaling up in Nepal and Haïti



### Perspectives/issues/ambition:

- ✓ **PEPR IRIMA and VETIVER initiative on Island Risks**
  - Multi-factor vulnerability assessment and reduction of island territories in Nouvelle-Calédonie (Pacific) and La Réunion (Indian Ocean)
  - Identification of local building cultures and resilience factors
  - Inequality, Climate change impact and habitability
- ✓ **SHS 2024 Call of Interest**  
Contribution to UGA proposal on Climate Change Consequences



### ➤ Cross-cutting issues and collaborations with other clusters of the Risk Institute

- Development of shaking table equipment at 3SR (Telluric Cluster)
- Local communities empowerment – CIDARE project / univ. Of Swansea and partners (Resilience Cluster)

### Coordinators:

Julie DUGDALE (LIG, Computer Science)

Elise BECK (PACTE, geography)

Cécile CORNOU (ISTERRE, Seismology)/Pascal LACROIX (ISTERRE, Remote Sensing)

### Objectifs and expected results

- ✓ Telluric risk and crisis management models integrating various physical, psychological, social, spatial and temporal factors

### Methodology and tools

- ✓ Heterogeneous multi-source physical and social data available, especially during crises
- ✓ Back and forth between experimental data, proxies and simulations
- ✓ Risk perception quantitative and qualitative surveys
- ✓ Multi-agent modelling, Physics-based simulations, Artificial intelligence

### Multidisciplinarity

- ✓ Urbanism & Geography, Computer Science & AI, Applied Maths and Maths, Remote Sensing, Sociology, Psychology, Management Sciences, Seismology, Hydrogeology, Volcanology, Geomorphology

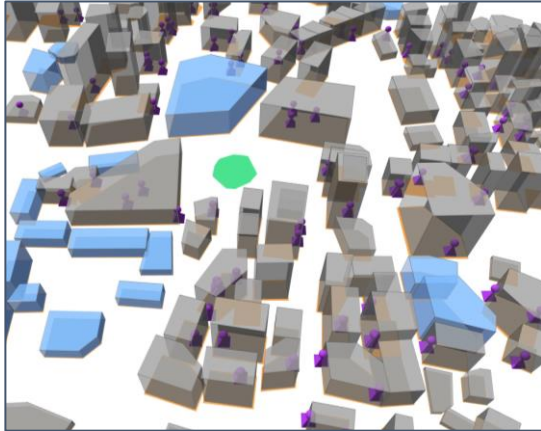
### Partnerships

- ✓ Scientific partners: **(UGA)** ISTERRE, LIG, PACTE, 3SR, LIP, GIPSA-Lab; **(Regional)** LISTIC, INSA Lyon; **(National)** IRSN, BRGM, IPGP, CEREGE, UGE, U. Bourgogne, U. Montpellier, EOST, GEOAZUR, CEREMA; **(International)** UK, Germany, Lebanon, Peru, Greece, Nepal, India, Algeria
- ✓ Non-profit organizations/interface structure: PARN, AURG, Grenoble Alpes Metropole, AFPS, AFPCNT

### Areas

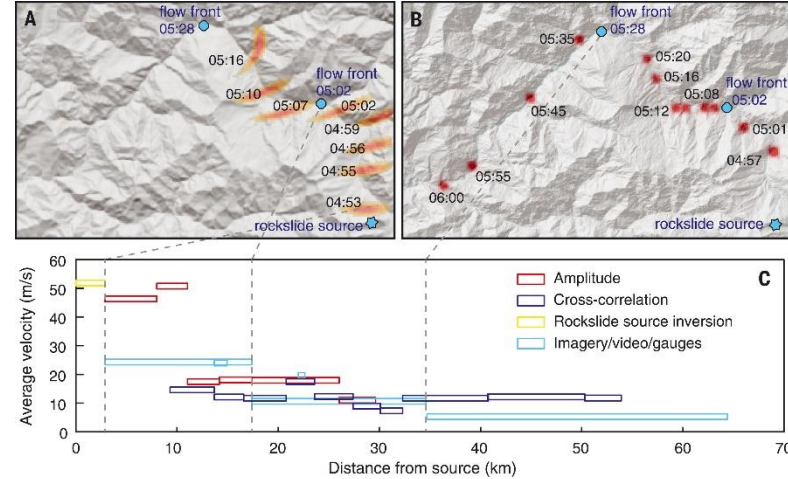
- ✓ France, Greece, Peru, Nepal, India, Algeria & Lebanon, Indonesia (International Research Networks)





*Interdisciplinary approach for agent-based simulation of seismic crisis including human behavior (Iskandar et al. 2024)*

Did you get out of the building you were in?		
	Yes %	No %
Gender		
Female	22.3	77.7
Male	29.4	70.6
Age		
18-24	23.5	76.5
25-39	28.4	71.6
40-64	22.9	77.1
65 and more	12.5	87.5
Presence of other people		
Alone	30.5	69.5
With other people	23.8	76.2
Buildings damage		
No	9.0	91.0
Yes, low damage	23.6	76.4
Yes, moderate damage	40.6	59.4
Yes, strong damage	57.1	42.9
Yes, totally destroyed	85.7	14.3



*Flow tracking combining heterogenous data & methods (Cook et al. 2021)*



*Urban health Citizen Observatory in Beirut (Lebanon) with low-cost sensors (Cornou et al. 2022)*

*On-line questionnaire on behaviors adopted during an event.*

When you were outside, what did you do?	%
I tried to meet up with family	50.0
I went to a safe area	30.2
I helped people near me	15.6
I followed someone	5.2
I went to hospital	4.2
I contacted relatives	2.6
I stayed where I was	2.1
Other	13.0
Total number of respondents	



*Displacement of funeral slabs and upthrown stones as new quantitative proxies of ground acceleration (Causse et al. 2021)*

## On-going projects

- ✓ Resilient societies through simulation (flooding, fires, earthquakes, etc)
- ✓ Earthquakes, climate change and cultural heritage (holy sites, prehistoric cave) at risk (with Anthropization cluster)
- ✓ Urban « health » citizen observatory in Beirut (Lebanon) for monitoring environmental (climate, seismic) and anthropogenic forcings
- ✓ New laboratory and experimental data for ground deformation and vibration (shaking table, grave stones, fiber optics, ...)
- ✓ From remote sensing data to physics-based simulations and proxies for hazard and risk models at a very high spatial resolution (from meters to tens of meters)
- ✓ Hazard prediction and risk perception

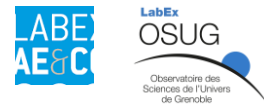
## Future work (about to start)

- ✓ Citizen observatory/data and science-society relation for co-building warning and alert systems (close interaction with Innovation cluster)
- ✓ Social media during crisis phases: to extract human behaviour and physical processes related to natural or industrial hazards (with Innovation cluster)
- ✓ Telecom fibre optics in the urban environment to estimate ground vibration indicators useful in earthquake seismology and engineering ...and population mobility (design stage)

## Animation/Collaboration & Education

- ✓ Continue to foster scientific animation and collaborations within the cluster (seminars, off-site days, common research projects, etc)
- ✓ Develop our partnerships at national and international levels (e.g. International symposium ESG2026 in Grenoble, new long-term international partnerships, International Research Networks, etc )
- ✓ Continue our involvement in Risk education, dissemination and transfer (RISK programme at Graduate School @ UGA, MOOC Remote sensing on natural hazard, etc)

Financed by:



### Coordinators:

Céline CHOLEZ (PACTE, Sociology of Innovation, Sociology of Risk)

Jean-François BOUJUT (GSCOP, Collaborative Design)

Jean-Luc BOSSON (TIMC/IMAG, Public Health)

### Objectifs and expected results

- To study and improve the design of 'citizen-centered innovations' that target individual and community empowerment in risk management (at every risk stage)
- **To what extent does involving the public concerned in risk management through innovative solutions (new technologies, new measurements, new governance) improve individual and collective resilience?**

### Methodology and tools

- Analysis of public policies targeting citizens and vulnerable populations through innovative solutions.
- Analysis and support of co-design projects involving citizens in technology and science development for risk management.
- Analysis of change in risk perception and management through the use of these solutions

### Multidisciplinarity

- Social sciences-driven academic issues: Architecture, Ergonomics, Geography, History, Political sciences, Psychology, and Sociology to address risk governance issues, technologies framing, risk perception, and management from different categories of actors and resilience boost
- Design and Engineering Sciences to develop new co-design methodologies involving different communities of practice
- Natural and Life Sciences to improve risk measurement and understanding, and risk management.



### Partnership

- Alps Institutions (municipalities, professional organizations, natural parks, etc.)
- Fab Labs (academic or industrial) and low-tech networks
- Grenoble Public Hospital
- Academic partnership with Swansea (UK) and Tsukuba (Japan) Universities



### Areas

Alps (France, Switzerland, Italy), French National territory, Lebanon, Morocco, Haïti...

### Main activities and Results

- A research field to build: « Innovations for resilience » regular workshops (13 presentations in 22-23 and 7 in 23-24)
- research projects: COVOMM (6 communications, 1 book in progress), FabInnov (2 communications, 1 article in progress)
- Funded research projects in progress:
  - ✓ Frugi-terre (1master+1phd- 2 labs): co-design for communities resilience in the Alps
  - ✓ Odiss'Loups (2 labs): Forster science/citizens dialogue about vulnerabilities associated with wolfs' presence
  - ✓ Regards d'altitude: construction of an observation tool for mountain risks, taking into account the perception of risks by professionals of mountains and citizen.
  - ✓ Citizen observatory of the «urban health» in Beirut (Lebanon): the social, political and anthropological dynamics at work in "citizen sensors", in connection with the telluric risk and crisis cluster
  - ✓ Research projects in design stages: Social media during crisis phases: to extract human behaviour and physical processes related to natural and industrial hazards (IRiMA Platform cluster) ; CIDARE (Citizen Data for Resilience) with the Universities of Swansea (UK), Amsterdam (NL) and Gratz (AT)
  - ✓ Participation to the Risk summer schools

# "On the right track but still some work to achieve"

- **Build an interdisciplinary risk institute within UGA:**
  - ✓ ~130 researchers from 21 labs organised in 5 interdisciplinary research clusters and around transversal challenges
  - ✓ Strong network of partners (private actors, stake holders): response to urgent needs regarding risks and required transformative changes
  - ✓ Vivid scientific animation within clusters and at the scale of the institute (research, link with partners)
  - ✓ Ability, despite limited budget, to access to sufficient funding at local, national and international levels, and from public and private funders
- **Bring UGA at a top-seed position in risk science from local to international levels:**
  - ✓ 30 papers/year, many of them promoting interdisciplinary approaches and news topics
  - ✓ Co-funding from large national and European projects (3/years)
  - ✓ A network of ~500 contacts, and reinforced relations with high priority partners
  - ✓ Internationalization of existing summer school
  - ✓ MOOCs (natural hazards, role of citizen and stakeholders in crisis managements)
- **Still missing: Formal status for the risk institute**
  - ✓ Existence on the long range
  - ✓ Specific place within a complex landscape



# Why further formalizing the Risk Institute?

- ✓ Our mission / goal acknowledged by UGA!
- ✓ Achieve a perennial construction on the long range
- ✓ Find a specific place within a complex research landscape
- ✓ Further reinforce the dynamics and results obtained so far (e.g. facilitate access to funding even more)
- ✓ And **what if not** ?
  - “Risk” to return to business as usual: “disciplinary research within labs”
  - Loose/stop the dynamics initiated so far
  - Miss the chance to give priority to one of the challenges of our time.



# How formalizing the Risk Institute?

- ✓ **Cartography** of the (complex!) research landscape: *done*
- ✓ Defining the **most suitable formal organization** (“federation”, “GIS”, etc.) for a strong but flexible institute well interfaced with existing structures

## French national research institutions

CNRS institutes:  
INSU, INSH, INEE,  
INSIS, INS2I, INSMI,  
INP...

National research organisms:  
INRAE, IRD, INRIA

Other national  
establishments :  
Météo France, BRGM, etc.

## National research programs and agencies

PEPR  
IRIMA

Other PEPRs :  
FORESTS,  
MathVives, etc.

New program  
agencies: CNRS,  
INRAE

## Grenoble Alps University

« poles » (environnement, social sciences, physics, maths, etc.), research labs, engineering schools, INP, IEP

**Risk Institute**

Other existing  
transversal structures

LABEX: OSUG, ITTEM, TEC21, PERSYVAL, AECC

Federations:  
OSUG, SFR Innovacs, FED3G

MIAI (IA institute)

## Existing interface structures

Local: PARN, IRMA

National: AFCPNT

International (to be developed):  
Belmont Forum, Future Earth

## Research partners

French Univ. &  
institutions:  
USMB, NCA,  
UCA, IRSN,  
BRGM, etc.

International:  
Tsukuba, Swansea,  
HSO Valais, Univ.  
from the Andeans,  
Mediterranean,  
Himalaya, etc.

## Partners

Small to large private companies

Local to national stake holders



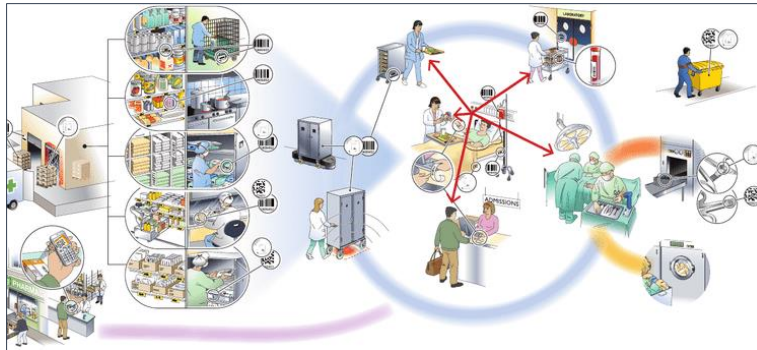
# Work in progress / next steps

- ✓ **Green light from the SAB to go on!**
- ✓ **Exchange with all the local and national structures potentially concerned to involve them in the project** (National research organisms, Labex and other interface structures already existing in Grenoble, research labs): ***almost completed***
  - Continue/reinforce joint work/activities
  - Choice of the formal organization for the institute (“federation”, “GIS”, etc.)
  - Formal links (including their role in the governance of the institute)
  - Support (including funding)
- ✓ **Propose a formal organization for a perennial Risk Institute** including governance mechanisms and functioning with a routine budget (Fall 2024). ***Get feedback and polishing the project to finalize it.***
- ✓ **In the meantime, initiate formal connections with similar international structures** (links and joint activities already existing are on the basis of researchers/labs/ongoing projects). ***SAB members may help!***
- ✓ **Formal kickoff of the risk institute** (Fall 2025).



- Challenges still there, every day more diverse and complex

*Hospital functioning during health crisis (@RMS)*



*Gonfaron megafire and crisis in 2021 (@Var Matin)*



- Research needs to be addressed within the institute (transversal, new clusters, etc.)

- Health system management in a context of a crisis (health, natural disaster, etc.)
- Impact of climate change and shrinkage of resources on risk occurrence, management, resilience and insurability: projections at different temporal horizons and support for action
- Human behavior within crisis and its consequences on impacts (including minimization)
- Territorial co-design of solutions to improve resilience, even against unexpected events
- Historical approach of risk management (complex interplays between risks and risk management)
- Technological and numerical innovation in risk monitoring and management: combined use of AI, remote-sensing and citizen sensors, digital twins, multi-agent modeling, etc.
- Multi-risks including compound and cascading events, domino effects etc. : systemic holistic approach, new formal developments, etc.





# Appendix 1: the 21 research labs of the Grenoble Risk Institute

**3SR** (géomécanique), **AE&CC** (architecture), **CERAG** (finances et marketing), **CNRM/Centre d'Etude de la Neige**, **CREG** (politique et économie), **EDYTEM** (politiques de montagne, environnement), **GAEL** (innovations économiques et industrielles), **GIPSA-lab** (modélisation), **G-SCOP** (management industriel), **IGE** (sciences du climat et de la cryosphère, risques en montagne), **INRIA** (informatique et numérique), **ISterre** (Sciences de la Terre), **LARHRA** (Histoire et société), **LEGI** (mécanique des fluides), **LETI-CEA** (diagnostique des systèmes et DATA), **LIG** (numérique, Ingénierie homme machine), **LIP-PC2S** (psychologie de la perception), **LJK** (modélisation et fiabilité des systèmes), **PACTE** (sociologie & ergonomie, prévention des risques), **TIMC-Imag** (sciences numériques modélisation santé).



# Appendix 2: Involvement of the Risk Institute in French PEPRs

## PEPR IRiMa



Provides the French risk science sector with **€51.9 million** for **8 years**, involving almost 30 French partner institutions and laboratories.

The Risk Institute was able to submit **more than 70 proposals** (PhDs, post-docs, equipment pieces, etc.) incubated within his clusters on the following topics:

- Mountain
- Risk and society
- Natech
- Platform
- Overseas

### Role of UGA / risk instate within IRiMa:

- National coordination (Didier Georges) with BRGM and CNRS
- Coordination of the mountain risk project (Nicolas Eckert)
- Program committee (Cécile Cornou, Nicolas Eckert)

## PEPRs, French programs for exploratory research and equipment on strategic topics

A PEPR is a national program funded by the French Ministry of Research to encourage collaboration between universities and national research organisms in order to boost emerging strategic scientific themes.

➤ For the 2023-2030 call, the Risk Institute contributed to:

- 
- **PEPR IRiMa** (*Integrated Risk Management for more resilient societies in an era of global change*)
  - **PEPR FORESTT** (*Forest resilience*)
  - **PEPR MathVives** (*Maths for biology and environmental sciences*)
  - **PEPR Solutions pour la ville durable et le bâtiment innovant** (*Solutions for sustainable cities and innovative buildings*)