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Risk Cross Disciplinary Project
Université Grenoble Alpes

4 years of research
on risk management & prevention

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2018-2021

INVESTIR L'AVENIR
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Cross Disciplinary Program
RISK@UGA

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EDITO

Didier Georges *(GIPSA-Lab)*
Project leader CDP RISK

….Four years already!

It has been 4 years now that the community working on risk assessment and management at the Grenoble-Alpes site has been federated within the interdisciplinary project CDP RISK funded by IDEX Université Grenoble-Alpes (initiative of excellence program funded by the French government).

It is important to recall that this research project, bringing together a wide range of scientific disciplines from geosciences and engineering sciences to humanities and social sciences, including digital sciences, had above all the objective of ensuring that research teams that had not worked together much or at all, could really collaborate, share knowledge and develop new approaches or tools for analysis and decision making.

It seems possible to affirm that this demanding interdisciplinary challenge has been taken up by all the actors of the project (about sixty people within 15 research labs regularly involved) whether they are young researchers, confirmed researchers or support staff made available to the community as evidenced by a number of indicators of success: since January 2018, 134 publications in journals of national or international audience, or in book chapters and 154 presentations in conferences of national or international audience have been made.

At least 15 master's degree internships have been supported within the framework of the project. Thanks to its interdisciplinary dynamics, the project has raised more than 2,7 millions euros in funding.

Finally, the scientific animation has been intense as evidenced by the thirty or so scientific meetings organized by the CDP RISK project since January 2018 in the form of research schools, seminars or webinars.

A doctoral students' club has been set up and has successfully contributed to the scientific animation of the young researchers' community. Thanks to our partnership with the Pôle Alpin des Risques Naturels, exchanges with the local authorities of the Grenoble-Alpes site have been consolidated.

International collaborations have been strengthened (with South American countries, Peru and Ecuador, Haiti, Lebanon, Nepal) or initiated (with Swansea University in the United Kingdom and Tsukuba University in Japan, in particular).

In order to show the diversity of the research work conducted within the CDP RISK@ Univ. Grenoble Alpes, we have chosen to place at the centre of this booklet the scientific contributions of our PhD students, supervised by experienced researchers from different disciplines. We hope that these presentations will allow you to appreciate the diversity and creativity of the young researchers and their supervisors.

We are now looking to the future with the aim of perpetuating this formidable project synergy. Based on our experience of working together, a project for a Risk Institute has been developed during the CDP RISK project. We hope to benefit from the institutional support necessary for its successful implementation in the years to come.

Before letting you enjoy reading this booklet, I would like to warmly thank, on behalf of the project steering committee, all the people who contributed to the success of the CDP RISK. I would like to start with the 11 doctoral students who have been the backbone of the project, all their supervisors, the coordinators of the project's work packages, all the researchers and partners who have contributed to our collective success through their activities and their participations in the scientific animation.

Finally, I would like to thank Sylvie for her effective assistance in our project development, and Julia for the precious administrative support provided by the IDEX administrative staff.

Enjoy your reading!

Didier GEORGES
CDP RISK Project Leader
On behalf of the steering committee

Sommaire

Meryem BOUSEBATA
PHD CDP RISK - INRIA

Best presentation award, certificate with bronze medal
10th conference of the international society for Integrated Disaster Risk Management (IDRiM), October 2019, Nice, France.

Bayesian estimation of extreme risk measures: Implication for the insurance of natural disasters

Supervisors: Stéphane Girard (LJK / INRIA), Geoffroy Enjolras (CERAG)

In recent decades, extreme weather events related to natural disasters and market deregulation have impacted agricultural production and income. Price volatility, increased by the globalization of trade in raw materials, and climate change are affecting the volume and quality of production, thus jeopardizing the survival of farms. Protection against climate and market risks fall within a good risk management and thus farmers' insurance coverage.

Thesis objectives
Contribute to the development of new statistical methods to model French farm income in order to study its insurability. Extreme value theory, Bayesian statistics and copulas are the three theoretical pillars on which my thesis is based.

Three main contributions

- The modelling of the dependency structure between the agricultural risks, using the statistical tool of copulas. Next, an overview related to the possibility of establishing farm income insurance is proposed.
- The second contribution is the proposition of a new approach, called Extreme-PLS, for dimension reduction adapted to distribution tails. The objective is to find linear combinations of predictors that best explain the extreme values of the response variable in a regression context.
- Since the applicability of extreme value methods is limited to large sample sizes, the scarcity of extreme events limits the availablility of data, my third contribution extends to Bayesian statistical methods. The main interest is to study how the introduction of prior information on the data can improve the estimation of extreme risk measures on small samples.

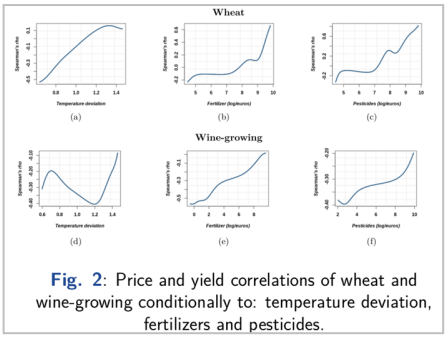


Fig. 2: Price and yield correlations of wheat and wine-growing conditionally to: temperature deviation, fertilizers and pesticides.

Finally, to face extreme events related to agricultural risks, we aim at adapting some financial instruments to cover the risk provided that they provide emergency financing and compensate farmers.

Year 1	- Bibliographical research and exploration of a large database extracted from the Farm Accountancy Data Network (FADN). -The study of the insurability of French farm income by modelling the dependency structure between agricultural risks conditionally on other covariates, using copulas.
Year 2	Development of a new methodology, called Extreme-PLS, for dimension reduction adapted to distribution tails. The performance of the method has been evaluated by numerical simulations, and an example of application to the French agricultural income of cereals has been provided as an illustration.
Year 3	Introduction of prior information on the data to improve the estimation of extreme risk measures on small samples.

Publications

. **M. Bousebata**, G. Enjolras & S. Girard, *Extreme Partial Least-Squares regression*, submitted, 2021. https://hal.inria.fr/hal-03165399/document
. **M. Bousebata**, G. Enjolras & S. Girard. *The dependence structure between yields and prices: A copula-based model of French farm income*, Agricultural and Applied Economics Association (AAEA), 2020. https://hal.inria.fr/hal-02933766/document

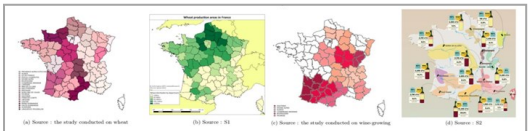


Fig. 3: Price/yield correlations (a,c) and wheat wine-growing productions (b, d) by region - Low (resp. high) correlations are in light (resp. dark) pink.

International conferences

. **M. Bousebata**, G. Enjolras & S. Girard. *The dependence structure between yields and prices: A copula-based model of French farm income*, European Association of Agricultural Economists (EAAE), July 2021, Prague, Czech Republic.
. **M. Bousebata**, G. Enjolras & S. Girard. *Extreme Partial Least-Squares regression,* Extreme Value Analysis (EVA), Jun 2021, Edinburgh, UK. [Video]
. **M. Bousebata**, G. Enjolras & S. Girard. *The dependence structure between yields and prices: A copula-based model of French farm income*, Annual Meeting of the Agricultural and Applied Economics Association (AAEA), August 2020, Kansas City, USA.
. **M. Bousebata**, G. Enjolras & S. Girard. Bayesian *estimation of natural extreme risk measures, Application to agricultural insurance*, 10th conference of the international society for Integrated Disaster Risk Management (IDRiM), Oct.2019, Nice, France.

National conferences

. **M. Bousebata**, G. Enjolras & S. Girard. *Extreme Partial Least-Squares regression*, 52èmes Journées de Statistique de la SFdS, 2020, Nice, France.
. **M. Bousebata**, G. Enjolras & S. Girard,*Bayesian estimation of natural extreme risk measures, Application to agricultural insurance*, Global Challenges Science Week: International interdisciplinary days of Grenoble Alpes, June 2019, Grenoble, France.
. **M. Bousebata**, G. Enjolras & S. Girard. Estimation *bayésienne des mesures des risques naturels extrêmes. Application à l'assurance du risque agricole*, Assises Nationales des Risques Naturels, March 2019, Montpellier, France.

Aurélie PEILLON
PhD CDP Risk - Laboratoire PACTE

Coordination of action between heterogeneous stakeholders in management of crisis

Supervisors: Sandrine Caroly (PACTE), Yann Laurillau (LIG)

Thesis objectives
Understand the collective work in order to prevent and manage avalanche situation which is considered as the management of a dynamic risk: an event with many uncertainties initially and evolving with time.

Avalanche Rescue Exercise, Jan.2020 - © A. Peillon

To manage the avalanche situation, it is necessary that the stakeholders on the ground as well as the decision-makers coordinate themselves in order to adapt to rapid changes in the situation. We want to understand the links between different stakeholders involved in collective activities to manage the avalanche situations: how do they communicate with each other? What is the nature of the information mobilized and shared?

The project will also help to design a groupware for supporting the coordination of the stakeholders in avalanche crisis management. The different analyses offer possibilities to design one or multiple user interface that consider the heterogeneity of user's profiles and facilitate coordination among stakeholders. This is a multidisciplinary approach between ergonomics and computer science.

Main results: crisis representation and the management of a natural risk

The crisis representation for the stakeholders involved into avalanche situation show that the avalanche itself is not a crisis for mountain professionals: it's a part of their activities. But when carrying out rescue related to an avalanche, there may be external or internal elements that complicate the situation and degrade the realization of the relief (bad weather conditions, lack of communication between different stakeholder…). The results show also the importance of the temporal pressure and the urgency perceived by the rescuers. The filmed observations made during the simulation show the management activity with anticipation of potential developments in the situation and the need to the uncertainties. The effective management of the situation relies on a coherence of representations between the actors in the field and the remote manager. We assume that good communication is needed between the actors in the field and the manager.

Avalanche Rescue Exercise, 2015 - © Th. Jouve

Year 1	Twenty-five interviews were conducted with stakeholders who have a role in avalanche prevention and management in the Northern French Alps
Year 2	Observations were conducted into 2 ski station: La Plagne (6 weeks) and les 7 Laux (2 weeks)
Year 3	observations were conducted during a simulation of avalanche rescue situation. We filmed the avalanche simulation and the activities that were carried out by the rescuers. Following these films, we conducted interviews with the rescuers.

International conference

. Peillon, A., Caroly, S., Laurillau, Y. & Richard, D. (2020). *La gestion de la situation d'avalanche et les facteurs de basculement vers la crise*. Actes du 55ème Congrès de la SELF, *L'activité et ses frontières. Penser et agir sur les transformations de nos sociétés*. Paris, 16, 17 et 18 septembre 2020.

Scientific poster :

. Peillon, A., Caroly, S., Laurillau, Y., Richard, D. (2019). *The different crisis representation in avalanche management: exploratory study.* Science week 2019. Grenoble

. Peillon, A., Caroly, S., Laurillau, Y., Richard, D. (2019). *The crisis representation between heterogeneous stakeholders in avalanche management*. IDRIM 2019. Nice

Popular science

. Peillon, A. (2019). *Méthodes de recherche en sciences sociales. Application à l'ergonomie*. Fête de la Science 2019. Grenoble

. Combey, A., **Peillon**, A., Cusicanqui, D., Rakotonirina, M., Hagl, M., (2020). *Aleas naturels et sociétés, une question de RISK*. The Conversation. https://theconversation.com/aleas-naturels-et-societes-une-question-de-risk-145399

. Peillon A. (2021). *Gestion collective de la crise en cas d'avalanche*. Institut des Risques Majeurs. http://www.irma-grenoble.com/01actualite/01articles_afficher.php id_actualite=729&fbclid=IwAR3jc3BmbKi1d44O4sDMmeVgJUIBA93GZNBj0LJoDvn7ZJlBFaJw1X3Wog8

Maria HAGL
PhD CDP RISK - LIP/PC2S

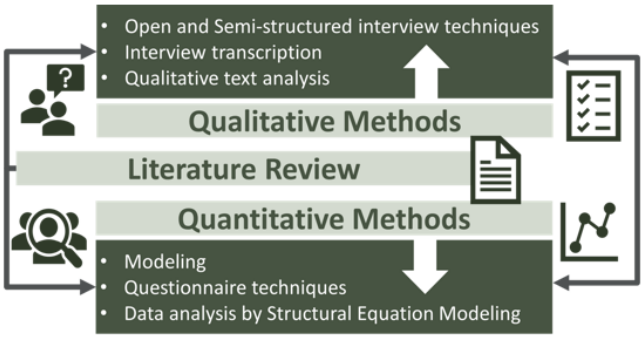
Testimonies, perception and management of landslides hazards

Supervisors: Rémi Kouabénan (LIP), Denis Jongmans (ISTerre), Philippe Schoeneich (IUGA)

Thesis objectives
Through interviews and open-ended questionnaires, experts and the local population provide precious inputs to enrich the scientific debate on landslide risk perception and management.

How risky do you live? Uncertainty is a part of human life. Risk comes along with every choice you make, but one can also involuntarily be exposed to hazardous environments. From a human perspective, risks can be perceived and evaluated differently. When it comes to natural hazards, there is no unanimous answer to how safely one can live in a risk prone area. Inactive and active landslides in the Trièves region affect the local population in different ways and to a varying extent. In addition to geotechnical instrumentation and monitoring, it is essential to consider the residents' risk perception. Their knowledge, experience and opinions can give us valuable insight to better prevent and manage landslide hazards bottom-up.

Based on the qualitative field studies and completed by existing scientific literature, a model measuring psychological, geographical, and socio-economic determinants that predict risk perception, perception of protective measures and protection motivation is developed. The empirical testing of the model is carried out by quantitative survey methods.



Publications

. Hagl, M., Kouabenan, D. R., Jongmans, D., Schoeneich, P. (2020). *Testimonies of Landslide Hazards: Past, Present and Futur Aspects of Risk Perception and Management by Local Residents of the Trièves Area*. In *V International Congress on Risks,* 12-16. Oct. 2020, Coimbra, Portugal.

. Combey, A., Peillon, A., Cusicanqui, D., Rakotonirina, **M., Hagl**, M. (2020, October 29). *Aléas naturels et sociétés, une question de "RISK"*. The Conversation. https://theconversation.com/aleas-naturels-et-societes-une-question-de-risk-145399

. Hagl, M., Kouabenan, D. R., Jongmans, D., Schoeneich, P. (2020, December 9). *Témoignages, perception et gestion des risques liés aux glissements de terrain.* Institut des Risques Majeurs.
http://www.irma-grenoble.com/01actualite/01articles_afficher.php?id_actualite=721

Nour CHAHROUR
PhD. CDP RISK/INRAE - GIPSA-Lab

Physics-Informed Deterioration Modeling and Maintenance Optimization Using Stochastic Petri Nets: Application to Torrent Protection Structures

Supervisors: Christophe Bérenguer (GIPSA-lab), Jean-Marc Tacnet (INRAE)

IMechE Safety and Reliability Group prize for Best Contribution by Young Professional *- 11th MIMAR conference, 2021*
Best Poster presentation (9th place) *- 10th IDRIM conference, 2019*
Best presentation *- Journée des doctorants à l'école doctorale EEATS, 2019*

Thesis objectives

- **Proposing a physics-based model that models the time-dependent state-evolution of protection structures when being subjected to torrential phenomena considering cascade effect;**
- **Developing a stochastic deterioration and maintenance model using stochastic Petri net tools (SPNs) in order to support maintenance decision-making of protection structures considering economic aspects;**
- **Analyzing the performance/behavior of different types of protection structures (e.g. check dams, retention dams) using the developed modeling approach;**
- **Propagating uncertainty within the deterioration and maintenance model and performing a sensitivity analysis in order to assess the effect of information imperfection on made decisions.**

This Phd project has merged several disciplines in order to provide a contribution for solving the key issue of optimizing maintenance solutions related to critical protection structures implemented in mountains. A new dynamic decision-support approach is proposed for comparing maintenance strategies over the lifetime of these structures while considering dependencies and cascading effects. This methodology builds bridges between approaches classically used for technological and natural risks coping with information imperfection consisting in imprecise data, uncertain raw data and in expert knowledge. It has led to the development of new deterioration models for civil engineering structures, integrating interdependencies between structures within a network. The developed process couples multi-scale hydraulic analysis (from global bed evolution to check dams' local scouring analysis), civil engineering approaches (stability analysis) and uncertainty analysis to assess failure states. Physics-based models are themselves coupled with reliability-based models (SPNs, CBM) in order to propose and justify transition laws involved in the stochastic degradation process. This produces an innovative but also generic, versatile solution for other complex interdependent critical infrastructures.
The PhD defense took place on October 25, 2021.

Publications

. N. Chahrour, M. Nasr, J.-M. Tacnet, Ch. Bérenguer, *Deterioration modeling and maintenance assessment using physics-informed stochastic Petri nets: Application to torrent protection structures*, Reliability Engineering & System Safety, 2021, 107524, ISSN 0951-8320, https://doi.org/10.1016/j.ress.2021.107524.

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer, (2021). *Deterioration Modelling and Preventive Maintenance of Critical Torrential Protection Structures towards Improved Resilience – A Petri Net based Approach*. Chapter in Resilience Engineering and Modelling of Networked Infrastructure, ESReDA Project Group. hal-03408080

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer, *Reliability and Maintenance Efficacy Assessment of Torrent Protection Measures under Information Imperfection.* 31st European Safety and Reliability Conference, ESREL 2021, Sep 2021, Angers, France.

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer, *Cascade Effect Analysis in Torrential Context for Prioritizing Check Dams Maintenance strategies,* 67th Annual Reliability and Maintainability Symposium (RAMS), 2021, Orlando, Florida, US. hal-03262677

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer, *Cascading Effect Analysis in Torrential Hazard Context for Prioritizing Check Dams Maintenance Strategies.* The 11th IMA International Conference on Modelling in Industrial Maintenance and Reliability MIMAR, June – July 2021 (Online).

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer, C. Folleau, C. Vinuesa, *Aide à la Décision pour la Maintenance Préventive des Ouvrages de Protection Contre les Risques Naturels en Montagne*, Lambda Mu 22 (e-congrès) - 22ème Congrès de Maîtrise des Risques et de Sûreté de Fonctionnement, Institut pour la Maîtrise des Risques, Oct 2020, Le Havre (e-congrès), France. pp.490-499. hal-03029180

. N. Chahrour, S. Hariri, J.-M. Tacnet, Ch. Bérenguer, *A Modeling Framework for Efficacy Assessment and Preventive Maintenance of Torrential Protection Works*. 29th European Safety and Reliability Conference, ESREL 2019, Sep 2019, Hannover, Germany. pp.444-451, 10.3850/978-981-11-2724-3_0327-cd. hal-02318144

. N. Chahrour, S. Hariri, J.-M. Tacnet, Ch. Bérenguer, *Degradation Analysis and Preventive Maintenance Modelling and Assessment for Improved Resilience of Critical Infrastructures - Application to Torrent Checkdams.* 56th ESReDA Seminar On Critical Services continuity, Resilience and Security, May 2019, Linz, Austria. Paper #11 - 12 p. hal-02320794

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer. Risk Management and Resilience Assessment of Protection Works against Natural Hazards in Mountains: Petri Net based Approach for Prioritizing Preventive Maintenance Strategies. 10th conference of the international society for Integrated Disaster Risk Management, International Society for Integrated Disaster Risk Management, Oct 2019, Nice, France. hal-02321266

. N. Chahrour, J.-M. Tacnet, Ch. Bérenguer(2020). *Maintenance Decision Support of Torrent Protection Structures Subjected to Natural Hazards*. European Safety and Reliability Association. ESRA Newsletter September 2020, page 8.

Diego CUSICANQUI
PhD. CDP RISK - EDYTEM

Emerging risks related to the 'dark side' of the Alpine cryosphere

Supervisors: Antoine Rabatel (IGE), Xavier Bodin (EDYTEM)

Thesis objectives
To achieve a deeper understanding of the long-term processes and internal structure that govern the behavior of landforms that are typical of the glacial and periglacial systems (e.g., rock glaciers, debris-covered glaciers) and their connections to the changing climate conditions, related to natural hazards under the context of mountain permafrost degradation by gathering a multidisciplinary approach, thought various sites and multi-method combination.

The overarching aim of this thesis is to Pluridisciplinarity. This thesis represents a cross-disciplinary collaboration between geography, geosciences, geophysics and engineering. This work have been developed between two institutions: the Institute of Geosciences of the Environment (IGE) at Grenoble Alpes University in Grenoble and EDyTEM laboratory in Chambéry at Savoie Mont-Blanc University and close collaborations with governmental institutions like Land and Mountain Restoration Department (RTM) from National Forestry Office (ONF), all of them within the framework of the cross-disciplinary project (CDP) RISK@UGA funded by the *Université Grenoble Alpes*.

In this sense, the most outstanding points of this contribution are the application of different methodologies that complement each other, such as photogrammetry for long term monitoring and 3D evolution thought time. Also, geophysics, which allows a better understanding of the internal structure of these landforms and geomorphology, to characterize the processes and elements, which are interacting together on the surface. All this conjunction, with the goal to better understand the impacts of climate change on mountain permafrost.

In the same way, we proposed semi-automated tools for long-term monitoring and morphdynamics quantification. Additionally, the application of typical methodologies in glaciology were satisfactorily implemented in this work, which is a valuable tool from this work and allows opening new doors in the investigation of mountain permafrost dynamics, related to natural hazards and risk mitigation.

Stage 1	Literature revision: Read about mountain permafrost environments thought scientific articles, books, sites selection and goals definition.
Stage 2	Data processing and analysis: Data processing using computational capabilities and data analysis.
Stage 3	Discussion: During this process, many hours of discussions and brainstorming between colleagues and specialist. An special focus was made about the limitations from techniques and interpretations coming from different study cases
Stage 4	Publication: Preparation of scientific publications to be submitted to peer-review journals. This stage include also communications on international symposiums, local conferences and with local authorities.

Publications

. Lehmann, B., Anderson, R., Bodin, X., **Cusicanqui, D.**, Valla, P., Carcaillet, J. (***In prep.***). Reconstruction *of rock glaciers activity in an Alpine environment, from modern to Holocene timescales.*

. Revil, A., Duvillard, P.A., Vaudelet, P., **Cusicanqui, D.**, Bodin, X., Schoeneich, P. (***In prep.***). *Determining water content under thermokarst lake in a rock glacier from electrical conductivity and induced polarization tomography*

. Le Roy, M., Schimmelpfennig, I., Deline, P., Schoeneich, P., Carcaillet, J., Leger, T., Jégot, P., **Cusicanqui, D.**, Bodin, X., Hofmann, M., ASTER Team. (***In preparation***). *Holocene history of Arsine glacier, Ecrins-Pelvoux Massif* (southern French Alps).

. Beraud, L., **Cusicanqui, D.**, Rabatel, A., Brun, F., Vincent, C., Six, D. (***Under review***). *Glacier-wide seasonal and annual geodetic mass balances from Pléiades stereo images. Application to the Glacier d'Argentière, French Alps. Journal of Glaciology.*

. Vincent, C., Gilbert, A., Walpersdorf, A., Gimbert, F., Gagliardini, O., Jourdain, B., Roldan Blasco, J. P., Laarman, O., Piard, L., Six, D., Moreau, L., **Cusicanqui, D.,** Thibert, E. (***Under review***). *Evidence of seasonal uplift in the Argentière Glacier (Mont Blanc area, France). Journal of Geophysical Research: Earth Surface.*

. **Cusicanqui, D.**, X. Bodin, A. Rabatel, P.A. Duvillard, P. Schoeneich, J. Berther, A. Revil. (***Under review***). *Investigating the multi-decadal (1948-2020) thermokarst dynamics of the Chauvet glacial and periglacial complex, Southern French Alps.*

. Duvillard, P.A., **Cusicanqui, D.**, Charonnat, B., Marcer, M., Revil, A., Menard, G., and Schoeneich, P. (***Under review***). *Evolution of thermokarsts over seven decades in an Alpine ice-rich complex rock glacier.*

. **Cusicanqui, D.**, Rabatel, A., Vincent, C., Bodin, X., Thibert, E., & Francou, B. (2021). *Interpretation of volume and flux changes of the Laurichard rock glacier between 1952 and 2019, French Alps*. *Journal of Geophysical Research: Earth Surface*, 126, e2021JF006161. https://doi.org/10.1029/2021JF006161.

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Conference publications and communications

. **Cusicanqui, D.**, Duvillard, P. A., Charonat, B., Marcer, M., Bodin, X., Rabatel, A., Schoeneich, P., Revil, A., Berthet, J., and Menard, G. (2021). *Investigating thermokarst lakes evolution over seven decades in two Alpine glacial and periglacial environments, French Alps. SHF Conference (Glaciologie, Nivologie, Hydrologie et Permafrost de Montagne)*. Grenoble, France.
. **Cusicanqui, D.**, Rabatel, A., Bodin, X., Vincent, C., Thibert, E., Duvillard, P. A., and Revil, A. (2021). *Using historical aerial imagery to assess multidecadal kinematics and elevation changes. Application to mountain permafrost in the French Alps*. *EGU General Assembly 2021*, online, 19–30 Apr 2021, EGU21-16371, https://doi.org/10.5194/egusphere-egu21-16371.
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. Schoeneich, P., Bodin X., Ravanel, L., Duvillard, P.A., Marcer, M., Echelard, T., Charvet, R., Revil, A., **Cusicanqui D.** (2021). *The PermaRisk project -Emerging hazards due to mountain permafrost degradation in the French Alps*. 14th INTERPRAEVENT Congress – *Natural hazards in a changing world*, May 31st - June 2nd 201, ISBN 978-3-901164-28-6. Paper available online.
. **Cusicanqui, D.** and Bodin, X. (2019). Webinar at INDURA, *Photogrammetry for the study of mountain slopes*. Free available at: https://vimeo.com/473376992. *[French version]*
. **Cusicanqui, D.**, Rabatel, A., and Bodin, X. (2020). *60 years of rock glacier displacements and flux changes over Laurichard Rock glacier, French Alps*. *EGU General Assembly 2020*, Online, 4–8 May 2020, EGU2020-10373, https://doi.org/10.5194/egusphere-egu2020-10373.
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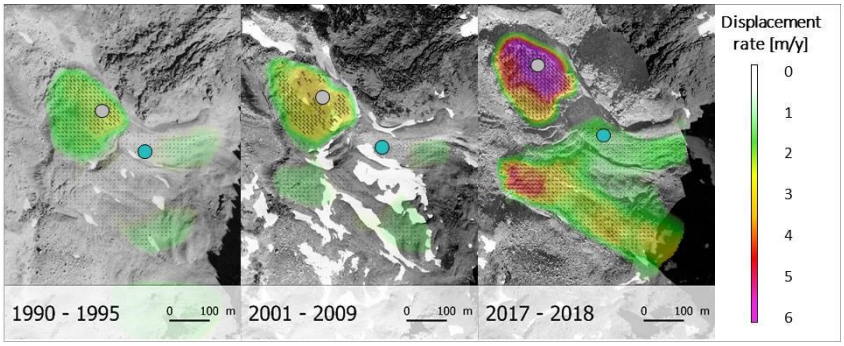
Highlights

. Anne Rowan, associated editor of Journal of Geophysical Research Earth Surface have highlighted our work at EOS.org, which is a high impact magazine from AGU where news about recent works are presented, intended primarily for the general public.
The post can be reade following this link Revealing How Rock Glaciers Respond to Climate Change.



Mohit Mehendra MISHRA
PhD. CDP RISK - GIPSA-lab

Modeling and information reconstruction from heterogeneous data in the context of gravitational hazards – Application to Harmalière's landslide

Supervisors: Gildas Besançon (GIPSA-lab), Guillaume Chambon (INRAE), Laurent Baillet (ISTerre)

Thesis objectives
A physics-based dynamical model of landslides, unknown parameters identification, and observer-based hazard evaluation from available measurements.

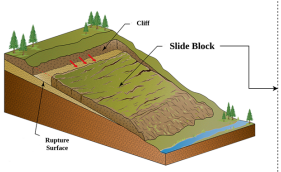
In this challenging context of landslide monitoring and forecasting, this requires a multi-disciplinary approach, i.e., concepts from geophysics and control theory for model structure definition and solution methods for observer problems (or parameter identification), respectively. In short, analyzing the change in landslide variables and mechanical parameters prior to or while in a motion.

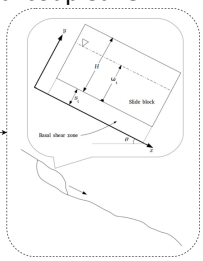
Contribution of this work to the fields of research

Landslide is a gravity-driven downslope movement of soil, debris, or rock near the earth's surface. It can display heterogeneity in rates and movement types, ranging from catastrophic acceleration to creeping motion. Both scenarios pose a threat to the exposed region's people, infrastructure, ecosystem, and economy. Traditional landslide risk management strategy suggests avoiding building new infrastructure in such a region based on hazard maps. However, with climate change and rapid urbanization, this strategy seems challenging to implement.

Therefore, Early Warning Systems (EWS) are way forward to take timely corrective measures to reduce life and economic losses. These EWS's rely on landslide monitoring systems, landslide models, and information reconstruction schemes.

In the first of our study, we formulated state and parameter estimation issues in an ODE-PDE landslide model as an optimization problem with discrete-time asynchronous synthetic measurements. The calculus of variation based adjoint method (iterative approach) is then utilized to solve the problem. Secondly, we address a similar state and parameter estimation problem in a coupled ODE-PDE landslide model by designing an Observer again for synthetic measurements (continues approach). The observer consists of a copy of the PDE part of the system and a Kalman-like observer for the ODE. It is shown to ensure exponential convergence of the state and parameter estimates employing the Lyapunov tool. Finally, we present an approach for reconstructing displacement patterns and some unknown soil properties of slow-moving landslides, using a special form of the so-called Kalman filter or observer. This approach is validated for the Super-Sauze landslide data from the literature with an extension of the observer to forecast landslide displacement.





Literature Review (Landslide Monitoring and Modeling)	Oct.2018 - Sept.2019
Problem 1 - Optimal parameter estimation problems for a landslide model	Oct.2019 - March 2020
Problem 2 - Observer design for state and parameter estimation in a landslide model	April 2020 - Sept.2020
Problem 3 - Combined state and parameter estimation for a landslide model using Kalman filter	Oct. 2020 - March 2021
Problem 4 - Reconstruction and forecasting of landslide displacement using a Kalman filter approach	April 2021 - June 2021
Problem 5 - Calculus of variations for estimation in ODE-PDE landslide models with discrete-time asynchronous measurements	July 2021 - Oct. 2021

Publications

. Mishra, M., Besançon, G., Chambon, G., and Baillet, L. (2021). *Calculus of variations for estimation in ODE-PDE landslide models with discrete-time asynchronous measurements*. (will be submitted to the International Journal of Control)

. Mishra, M., Besançon, G., Chambon, G., and Baillet, L. (2021). *Reconstruction and forecasting of landslide displacement using a Kalman filter approach*. (will be submitted to the Journal Landslides)

. Mishra, M., Besançon, G., Chambon, G., and Baillet, L. (2021). *Combined state and parameter estimation for a landslide model using Kalman filter*. 19th IFAC Symposium on System Identification SYSID 2021, 54(7), 304-309, doi:10.1016/ j.ifacol.2021.08.376.

. Mishra, M., Besançon, G., Chambon, G., Baillet, L., Watlet, A., Whiteley, J. S., Boyd, J. P., and Chambers, J. E. (2021). "Application of Kalman filter to reproduce displacement pattern along with the unknown soil properties of slow-moving landslides". EGU General Assembly 2021, Online, 19-30 Apr 2021, EGU21-9396, Doi:10.5194/egusphere-egu21-9396.

. Mishra, M., Besançon, G., Chambon, G., and Baillet, L. (2020). "Observer design for state and parameter estimation in a landslide model". 21th IFAC World Congress, 53(2), 16709-16714, Doi:10.1016/j.ifacol.2020.12.1116.

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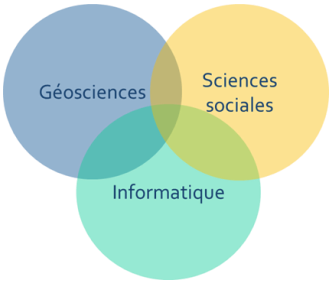
Rouba ISKANDAR
PhD. CDP Risk - ISTerre

An integrated seismic risk modelling approach including human behaviour

Supervisors: Elise Beck (PACTE), Cécile Cornou (ISTerre)

***first prize of the Young Scientist award**.10th conference of the international society for Integrated Disaster Risk Management (IDRiM), October 2019, Nice, France.*

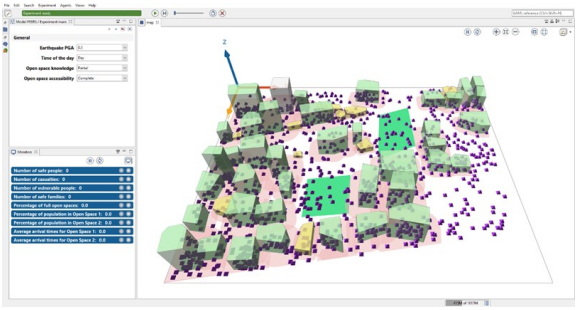


Thesis objectives
Developing an interdisciplinary multi-model of seismic risk: a global model that integrates underlying models of seismic hazard, physical and social vulnerabilities as well as human behaviors when faced with sudden catastrophic events.

This work aims to improve the transdisciplinary modeling of seismic risk, while also taking into account the limited knowledge we have and the difficulty in classifying the different components of risk.

Contributions of the work to research

- An interdisciplinary literature review on seismic risk, offering a comprehensive view on the notion of risk and how it is tackled in different disciplines.
- The development of an agent-based model for pedestrians' earthquake evacuation that integrates realistic human behaviors derived from survey data, as well as the social context behind decision-making in crisis.
- The development of methodologies to collect and produce data, from widely accessible heterogeneous open-source data.
- The analysis of the problematic of the accessibility of open spaces in urban areas.
- The development of a seismic risk index that integrates both the physical and social components of risk.



Phase 1	Reviewing the available literature on seismic risk, human behaviors in crisis and agent-based modeling. The literature review allowed to conceptualize an agent-based model for the simulation of pedestrians' evacuation in earthquakes.
Phase 2	Then the data required for the model were collected, which required developing methodological frameworks to derive useful data from heterogeneous open source data. Additionally, a survey following the explosion of the Beirut port was conducted to collect data on human behaviors in crisis.
Phase 3	After implementing, validating and calibrating the model, an experimentation plan was defined and several scenarios were simulated in order to identify how the seismic risk is influenced by a set of different factors.

Publications

. Iskandar, R., Dugdale, J., Beck, E., Cornou, C., 2021. PEERS*: An integrated agent-based framework for simulating pedestrians' earthquake evacuation.* ISCRAM 2021 Conference Proceedings – 18th International Conference on Information Systems for Crisis Response and Management, Blacksburg, VA, USA: Virginia Tech, pp. 86–96.

. Iskandar, R., Allaw, K., Dugdale, J., Beck, E., Adjizian-Gérard, J., Cornou, C., Harb, J., Lacroix, P., Badaro-Saliba, N., Cartier, S., & Zaarour, R. 2020. *Agent-based simulation of pedestrians' earthquake evacuation; application to Beirut, Lebanon*. 17th World Conference on Earthquake Engineering, Sendai, Japan.

. Iskandar, R., 2020. *Modélisation du risque sismique à Beyrouth (Liban) : comment prendre en compte le comportement humain ?* Site web de l'Institut des Risque Majeurs (IRMa) : http://www.irma-grenoble.com/01actualite/01articles_afficher.php?id_actualite=726

. Iskandar, R., Cornou, C., Beck, E., Dugdale, J., 2019. *Seismic risk modeling including human behavior*. Session poster présentée à la Global Challenges Science Week, International interdisciplinary days of Grenoble Alpes, 3-6 June 2019, Grenoble, France. (poster)

. Iskandar, R., Al-Tfaily, B., Salameh, C., Bard, P.Y., Guillier, B., Cornou, C., Gérard, J., Harb, J., Fayjaloun, R., Beck, E., Dugdale, J., 2019. *Modélisation des dommages sismiques à Beyrouth (Liban) combinant les comportements du sol et du bâti*. 10e Colloque National de l'Association Française du Génie Parasismique, 24-27 September 2019. Strasbourg, France. (poster)

. Iskandar, R., Al-Tfaily, B., Salameh, C., Bard, P.Y., Guillier, B., Cornou, C., Gérard, J., Harb J., Fayjaloun, R., Beck, E., Dugdale, J., Lacroix, P., Cartier, S., 2019. Buildings *damage estimation at fine spatial scale for integrated seismic risk modeling in Beirut (Lebanon).* 10th conference of the International Society for Integrated Disaster Risk Management, 16-18 Octobre 2019. Nice, France. *Received the first prize of the young scientist award*.

Santosh YADAV
PhD. CDP Risk - 3SR

Experimental analysis of the seismic vulnerability of earth masonry reinforced with horizontal bands

Supervisors: Yannick Sieffert (3SR), Philippe Garnier (AE&CC), Florent Vieux-Champagne (3SR)

Thesis objectives
Study and compare the seismic vulnerability of two commonly used materials (timber and reinforced concrete) as a horizontal seismic band in masonry structures.

In 2015, there was a 7.8 Mw earthquake in Nepal, destroying more than 775000 buildings, and 9000+ people lost their lives. The Nepal authority again recommended the application of horizontal seismic bands during the reconstruction phase, which included the application of timber or reinforced concrete bands. There was a lack of quantified information for the structure's response in and the cost of these materials varies significantly because of their availability and difficult terrain condition of the country.

AE&CC research unit was involved in the reconstruction activity in Nepal. The main challenge was a lack of knowledge about the performance of the seismic band materials. AE&CC collected all the relevant information from the site and collaborated with 3SR laboratory to address the issue with a scientific approach. This experimental research work is carried out with the help of the interdisciplinary involvement of architects, engineers, and various stakeholders in Nepal.

Major contributions

A multi-scale experiments approach was used to quantify the influence of band materials in the structure. Comparing the performance of two materials, the results using reinforced concrete were better than that of timber band. However, at the reduced scale building tested on the shake table, both structures with the application of seismic bands had repairable damage compared to one without a seismic band. Also, the most critical location for the application of seismic band is recommended through several analyses. Shake table and reaction frame setup were developed during this research work at 3SR, which will be used to characterize the behavior of different types of construction in the future. A new method was introduced to optimize the shake table usages times.

Publications

. Yadav, S., Sieffert, Y., Vieux-champagne, F., Debove, L., Decret , D., Malecot, Y. & Garnier, P. (2021). *Optimization of the use time of shake table with specimen preparation outside the table surface* [Submitting to Journal of Experimental Techniques]

. Yadav, S., Sieffert, Y., Vieux-champagne, F., Malecot, Y., Hajmirbaba, M., Arléo, L., Crété, E. & Garnier, P. (2021). *Shake table tests on 1:2 reduced scale masonry house with application of horizontal seismic bands [*Submitting to Journal of Engineering Structures]

. Yadav, S., Sieffert, Y., Vieux-champagne, F., Garnier, P., Hajmirbaba, M., Arléo, L., & Crété, E. (2021). Dynamic *response of masonry structure with the application of horizontal seismic band: shake table tests* [5th International Conference Structures & Architecture]

. Crété, Eugénie, Julien Hosta, Eefje Hendriks, Aaron Opdyke, **Santosh Yadav**, Mampionona Rakotonirina, Olivier Moles, Prem Nath Maskey, Ramesh Guragain, Lumanti Joshi, Yannick Sieffert, Philippe Garnier, and Bill Flinn. (2021). Incorporating *Local Building Practices in Response*. Pp. 129–36 in *Roadmap for Research: A Collaborative Research Framework for Humanitarian Shelter and Settlements Assistance*.

. Damerji, H., **Yadav, S**., Sieffert, Y., Debove, L., Vieux-champagne, F., & Malecot, Y. (2021). Design *of a Shake Table with Moderate Cost. Experimental Techniques*. https://doi.org/https://doi.org/10.1007/s40799-021-00482-0

. Yadav, S., Damerji, H., Keco, R., Sieffert, Y., Crété, E., Vieux-Champagne, F., Garnier, P., & Malecot, Y. (2021). *Effects of a horizontal seismic band on seismic response in masonry structure: Application of DIC technique*. *Progress in Disaster Science*. https://doi.org/10.1016/j.pdisas.2021.100149

. Crété, E., **Yadav, S.,** Farahza, N., Arleo, L., Hajmirbaba, M., Sieffert, Y., & Garnier, P. (2020). *Understanding traditional anti-seismic strategies beyond their disappearance and distortions: Yazd Qajar Architecture case study*. In *12th International Conference on Structural Analysis of Historical Constructions*.

. Hosta, J., Garnier, P., Sieffert, Y., **Yadav, S.,** Joffroy, T., et al.. *State of knowledge and identification of research priorities for the scientific validation of disaster-resistant building cultures of the Himalayan regions of Nepal: Research report.* [Research Report] CRAterre; AE&CC; CDP Risk. 2020, 60 p. hal-03116968

. Crete, E., **Yadav, S**., Sieffert, Y., Hajmirbaba, M., Hosta, J., Mendes, M. F., Garnier, P. (2019). *Promoting Vernacular Architecture, A Basis for Building Back Safer? A Case Study from Nepal*. In A. R; (Ed.), *Structural Analysis of Historical Constructions* (Vol. 18, pp. 2457 –2465). Cusco, Peru: Springer. https://doi.org/10.1007/978-3-319-99441-3

. Damerji, H., **Yadav, S**., Sieffert, Y., Vieux-champagne, F., & Malecot, Y. (2019). *Damage Investigation Of Adobe Walls Using Numerical Damage Investigation Of Adobe Walls Using Numerical*. In *7th ECCOMAS Thematic Conference on Computational Methods in Structural Dynamics and Earthquake Engineering*.

. Yadav, S., Sieffert, Y., Crété, E., Vieux-Champagne, F., & Garnier, P. (2018). Mechanical *behavior of a different type of shear band connections being used in reconstruction housing in Nepal*. *Construction and Building Materials*, *174*, 701–712. https://doi.org/10.1016/j.conbuildmat.2018.04.121

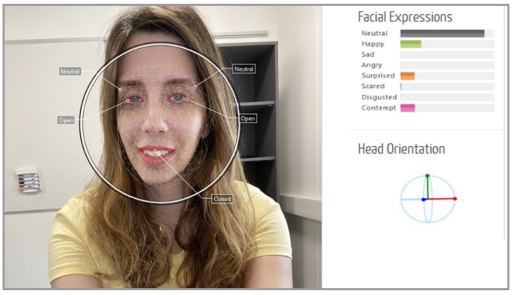
. Crété, E., **Yadav, S**., Hofmann, M., Vieux-Champagne, F., Sieffert, Y., Moles, O., & Garnier, P. (2018). *Timber seismic bandsX correlating their characteristics with local seismic activities and understanding their effects under seismic loads*. In *Inter-ISC'18*. Kastamonu, Turkey.

Mina ALIPOUR
PhD CDP RISK - LIG

The dynamic adaptation of Human - Computer Interfaces to a user's personal, contextual and behavioral responsiveness and decision-making in a natural risks program

Supervisors: Sophie Dupuy-Chessa (LIG), Eline Jongmans (CERAG)

Thesis objectives
Consider emotions in risk prevention, the PhD work investigates the impact of the dynamic of an adaptive interface on user preparedness and the prevention of natural hazards such as landslides, earthquakes, or floods.

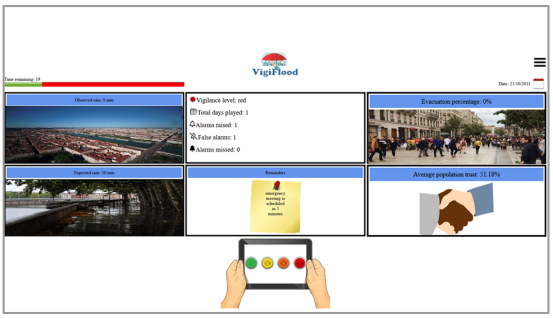


Decision-making can be difficult in the face of natural hazards. Emotions impact human behavior and decision making both before and during an incident. They affect the level of preparedness: eliciting negative emotions leads to an increase in risk perception and can potentially lead to behavioral adaptation. We propose to use emotions within disaster preparedness platforms and tools to help citizens prepare for the possibility of a natural disaster. To this end, user interfaces (i.e. widgets, colors,...) of platforms and preparedness tools can be adapted to arouse emotions.

To prevent or manage natural hazards, public policy programs are set in. The success of these programs depends on the understanding of the decision-making process of the population to take part in such programs driving to actual actions. Under some conditions of uncertainty, for instance when one is facing critical information related to his/her direct environment, the decision-making can be difficult. The creation of an information chain in an integrated governance of risk management requires the use of new technologies, both to collect information and to consolidate, integrate and disseminate it. In this context, our research work brings a double vision:

. In marketing, the problems to which this research contributes are: i) how do different types of emotions influence citizens' decision making about natural hazards? ii) how can the mediation of emotions increase the tendency to be prepared?

. In terms of human-computer interaction, one question has been investigated: which tool support can be proposed to adapt interfaces to respond directly to users' emotions in order to promote natural hazard prevention?



We created an adaptive interface for a serious game, which is an interesting support for enhancing the public risk perception and preparedness level by trying to push people to learn and experience a specific (negative/positive) situation. In terms of Human-Computer Interaction, this research studies the temporal aspect of interface adaptation. A conceptual framework and a software architecture taking into account several temporal dimensions and emotion models was developed so that it can be used by interface designers, developers and can be applied in different types of interfaces.

State of the Art	Years 1 to 3
Experiment	Year 1
Publication and writing	Years 1 to 3
Teaching and followed courses	Year 2 & 3
Prototype design and development	Year 2 & 3

Publications

. Alipour, M., Jongmans, E., Jeannot, F. and Dampérat, M. (2020), *An Empirical Impact Bias Approach for Natural Hazard Mitigation*, 11th Academy of Innovation and Entrepreneurship Conference (ACIEK), June, Spain, Madrid

. Alipour, M., Dupuy-Chessa, S. and Jongmans, E., (2020), *Disaster Mitgation Using Interface Adaptation to Emotions: a Targeted Literature Review.* 10th International Conference on the Internet of Things Companion, Sweden, Malmo.

. Alipour, Mina, Dupuy-Chessa, S. and Ceret, E., (2021), *An Emotion-Oriented Problem Space for UI Adaptation: From a Literature Review to a Conceptual Framework.* 9th International Conference on Affective Computing and Intelligent Interaction (ACII), Online.

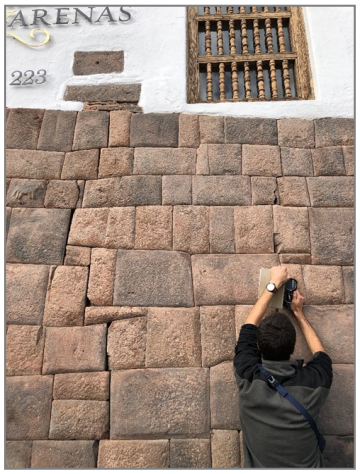
Andy COMBEY
PhD. CDP RISK - ISTerre

Archaeoseismological approach in the Heartland of the Incas (Cusco, Peru). Potentialities and limits for the current seismic hazard assessment and the past seismic risk perception

Supervisors: Laurence Audin (ISTerre), David Gandreau (AE&CC)

Thesis objectives
Demonstrate the relevance of studying monumental stone archaeological remains located in the region of Cusco (Peru) as complementary sources of information on the local past seismicity.

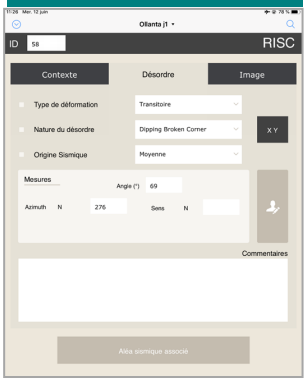
We carried out the first large archaeoseismological survey in the Andes and visited no more than 17 Inca sites of the Cusco area.



Fieldwork in Cusco (Peru)

We also developed and designed a relational database to support the data collection and storing. This work enables us to discuss the occurrence of earthquakes during the Inca period and address the impact of the local seismic hazard on the local populations and their behaviour (constructive culture, risk perception). In short, this research aims at fostering and promoting new approaches on the characterization of crustal earthquakes and improvement of the seismic hazard assessment. This project proves, finally, the relevance of cross-disciplinary research (involving archaeology, architecture, seismology) to improve our knowledge on the relation between earthquakes and past societies.

Contribution of this work to research



Documenting earthquake induced damage thanks to a Relational Database developed at the beginning of the PhD.

- Updating the definition and scope of the archaeoseismology – renewing the discipline in France.
- Providing visibility to the archaeoseismological field in South America. Thanks to this PhD project, we were able to carry out the first large archaeoseismological survey in the Andes. This research was also the opportunity to remind the need to reconsider the seismic hazard in this region.
- Highlighting the relevance of Earth Sciences and Earthquake geology to the understanding and management of the pre-Columbian Heritage in Peru.
- presenting and promoting the research through oral and poster sessions in conferences and colloquies of different specialities (archaeology, geology, earthquake geology, architecture …). These events were the opportunity to explore new partnerships and collaborations (Vienne, Chauvet Cave, Le Teil …).
- Fostering discussions and collaborations between several disciplines (seismology, archaeology, architecture), including bridges between the doctoral schools in term of methodological tools.
- "leverage effect" on the development and funding of interdisciplinary/cross disciplinary programs (INSU MITI).

October 2018 – February 2019	Literature survey
February 2019	Fieldwork
June 2019-September 2021	Archaeoseismological data processing + Preparation of articles
December 2019-October 2020	Ambient vibration campaigns + Post-seismic data processing from Le Teil sequence (11/11/19)
January 2020 – June 2021	Preparation of an article on Le Teil data
September 2021-December 2021	Currently writing the PhD manuscript

Publications

. Cornou C., J.-P. Ampuero, C. Aubert, L. Audin, S. Baize, J. Billant, F. Brenguier, M. Causse, M. Chlieh, **A. Combey**, …& de Michele, M. (2020). *Rapid response to the M_w 4.9 earthquake of November 11, 2019 in Le Teil, Lower Rhône Valley, France.* Comptes Rendus Geosciences, 10.31219/osf.io/3afs5.

. **Combey** et al. (2020). *Evidence of a large "prehistorical" earthquake during Inca times? New insights from an indigenous chronicle (Cusco, Peru).* Journal of Archaeological Science: Reports, 34(B), 10.1016/j.jasrep.2020.102659.

. **Combey** et al., (2021) *Documenting past seismic disasters and mitigating future earthquake hazard in the Andes: A database to support archaeoseismological investigations and Cultural Heritage preservation*, Journal of South American Earth Sciences, 111 10.1016/j.jsames.2021.103447.

. **Combey** et al., *Post-seismic survey of a historic masonry tower and monitoring of its dynamic behaviour in the aftermath of Le Teil earthquake (Ardèche, France).* Accepted to BSSA.

. **Combey** et al., *Reassessing the seismic hazard in the Cusco area: new contribution coming from an archaeoseismological survey*. To be submitted to Geoarchaeology *(in prep.)*

Mampionona RAKOTONIRINA
PhD. CDP RISK - AE&CC – CRAterre

3rd prize of the jury, Habitat soutenable dans un contexte de la solidarité internationale, doctoral workshop Innovative and sustainable Construction, Cité de la Solidarité Internationale, Annemasse, 2019.

Relevance and impact of interdisciplinary approach in post-disaster reconstruction: case of ANR ReparH project after the 2010 earthquake in Haiti

Supervisors: Thierry JOFFROY (AE&CC – CRAterre), Laurent DAUDEVILLE (3SR)

Thesis objectives

- **Understand how interactions between academic research and operational actions can be implemented in the post-disaster reconstruction phase;**
- **Understand the interactions between different academic and professional disciplines in post-disaster reconstruction interventions;**
- **Extract lessons learned from the Haitian experience in terms of relevant collaboration in post-disaster reconstruction phase that could be implemented in a similar case.**

This thesis is based on the context of housing reconstruction after the 12 January 2010 earthquake in Haiti, through interventions around the project *Reconstruire parasinistre en Haïti* (ReparH).

Methodology

A comprehensive posture has been chosen as a global approach for the thesis work. This led to adopt a qualitative research methodology in humanities and social sciences. The method of comprehensive interview has been chosen as a method for data collection. To treat and analyse the data, two main methods have been used: the method of a graphic representation in social sciences (mind mapping, concept mapping, social network mapping) and the method of qualitative data analysis supported by the NVivo software (thematic analysis of interviews and documentations).

Progress, results and contribution to research

After completing the data collection, the work is currently focused on mapping disciplines and actors (organisations and individuals) to understand and analyse their interactions. The first results of the analysis show that the involvement of complementary academic and professional disciplines, character skills and knowledge from different natures (academic, sociocultural) is an important factor for developing relevant responses to post-disaster reconstruction. These findings contribute to a better reflection and intervention of organizations that are involved in post-disaster reconstruction.

Publications

. Th. Joffroy, **M. Rakotonirina**, Ph.Garnier. *Regard réflexif sur le projet ReparH à Haïti : une exhortation à renforcer les liens entre action humanitaire et recherche,* Alternatives Humanitaires, 17 August 2021. https://alternatives-humanitaires.org/fr/2021/08/04/regard-reflexif-sur-le-projet-reparh-a-haiti-une-exhortation-a-renforcer-les-liens-entre-action-humanitaire-et-recherche/

. Crété, E., Hosta, J., Hendriks, E., Opdyke, A., Yadav, S., **Rakotonirina, M.**, Moles, O., Maskey, P., Guragain, R., Joshi, L., Sieffert, Y., Garnier, Ph., Flinn, B., *Incorporating Local Building Practices in Response* in Roadmap for research – A Collaborative Research Framework for Humanitarian Shelter and Settlements Assistance, InterAction, 129□36, 2021 *(book chapter)*

. **M. Rakotonirina**, Th.Joffroy, L.Daudeville, et Ph.Garnier. *Habitat parasinistre : objet interdisciplinaire entre territoire, culture et technique – Retour sur les interventions sur les Cultures Constructives Locales (CCL) après le séisme du 12 janvier 2010 en Haïti* in *Écocritique(s) et catastrophes naturelles – Sciences humaines et sciences naturelles : regards croisés (XXe-XXIe siècles)*, Presses universitaires Blaise Pascal (PUBP) *(in prep.)*

Oral presentations

. **M. Rakotonirina,** Th. Joffroy, L. Daudeville, Ph. Garnier, *Collaboration entre recherches et actions : une nécessité pour la réduction des risques de catastrophe ? Cas de la reconstruction d'habitat suite au séisme du 12 janvier 2010 en Haïti*. World Conference on Humanitarian Studies 2021, Panel *Bridging the gaps between knowledge and action in Disaster Risk Reduction* organized by the french Red Cross Foundation, Paris 4 November 2021.

. **M. Rakotonirina,** *Pertinence et impacts d'une approche interdisciplinaire dans les projets de reconstruction post-catastrophe : cas du projet ANR ReparH après le séisme de 2010 de Port-au-Prince*. Doctoral Day ENSAG, Grenoble, 11 April 2019.

. **M. Rakotonirina,** *Pertinence et impacts d'une approche interdisciplinaire dans les projets de reconstruction post-catastrophe : cas du projet ANR ReparH après le séisme de 2010 de Port-au-Prince* ». Matinée *scientifique « Risques »* - AE&CC / CDP Risk@Univ. Grenoble Alpes, Grenoble, 6 June 2019.

Popular science

. Combey, A., Peillon, A., Cusicanqui, D, **Rakotonirina, M.**, Hagl, M., *Aléas naturels et sociétés, une question de "RISK", The Conversation*, oct. 2020. http://theconversation.com/aleas-naturels-et-societes-une-question-de-risk-145399

. **M. Rakotonirina,** *Reconstruction d'habitat après le séisme de 2010 en Haïti : Comment collaborer ensemble ?*, Institut des Risques Majeurs (IRMa), 27 January 2021. http://www.irma-grenoble.com/01actualite/01articles_afficher.php?id_actualite=730

. **M. Rakotonirina,** *Allo docs : Comment reconstruire des maisons après une catastrophe naturelle ?,* Podcast of Fête de la Science 2021 at UGA, Hauteurs UGA, Grenoble, 07 October 2021. bit.ly/3mAz36x

• **Laura GATTINI** (M2), 2020

Etude de la cascade morpho-sédimentaire du bassin versant de la Griaz Approche géomorphologique, géohistorique et dendrochronologique [Study of the morpho-sedimentary cascade of the Griaz watershed: a geomorphological, geohistorical and dendrochronological approach]

(Supervisors: L. Astrade - EDYTEM, Ph. Deline - EDYTEM)

This internship finalise the geomorphological study of a very active torrential watershed, by integrating historical flood data from the RTM/ONF archives. This knowledge is essential for a quantitative approach to the location and volume of the sedimentary stocks that transit through the catchment as a result of the various processes that characterise it, starting with those linked to the torrent, and which will feed the load of future torrential floods.

Today, the anthropogenic impact on climate is causing irreversible changes in global weather patterns, particularly intense in mountain areas. The relationship between climate, connectivity and sediment transfer provides an understanding of how current landscapes have been sculpted. The coupling of geohistorical, geomorphological and dendrochronological methods has made it possible to reconstruct the evolution of the morpho-sedimentary cascade of the Griaz watershed (Chamonix Mont-Blanc valley). The connectivity between the sedimentary source and the hydrographic network is strong following wetter periods since the PAG. The role of climate on sediment connectivity is demonstrated. This work provides details on the transition between the PAG and today in a glacier-influenced catchment.

• **Camille LHUTEREAU** (M2), 2020

Débâcle de l'Oisans de 1219 [The Oisans debacle of 1219]

(Supervisors: Ph. Schoeneich - PACTE, F. Hobléa - EDYTEM, Ch. Crouzet - PACTE/USMB)

This project re-analysed the geomorphological data related to the historical break-up of the Lac d'Oisans in 1219. The detailed survey of the visible traces of the event (collapse deposits, fluvial terraces, scoured blocks, etc.) led to the reinterpretation of the conditions of the lake dam as a mixed landslide/torrential cone dam, to redefine the level reached by the lake, as well as to highlight the spectacular nature of certain witnesses, in particular the blocks scoured by the break-up, which testify to the violence of the current. This work will serve as a basis for enhancing the value of the site and for its inclusion in the geo-heritage inventory. The project was carried out as part of an M2 internship and led to the writing of a thesis. The work was the subject of several communication operations, during and after the research: public conference, article in a book, communications in colloquiums, and should be continued by a scientific excursion in spring 2022.

• **Abdelhamid MAHFOUD** (M2), 2020

Modeling and statistical analysis of boulder avalanche run-outs

(Supervisors: F. Leblanc - LJK, D. Daudon- 3SR, V. Couallier - UBX)

This internship allowed a first excavation of data previously acquired by other acquired by other trainees (UGA excellence courses). A model taking into account the censorship of the data and a choice of model

A model taking into account the censorship of the data and a choice of model best adapted to the situation is then adjusted on the available data. The contribution of Abdelhamid Mafhoud has made it possible to identify a number of interesting avenues of research, to initiate a collaboration with a colleague from the University of Bordeaux (Vincent Couallier) and to build a SARRA21 project that has been selected among those labelled by the IRGA21 (Initiative of excellence at Grenoble Alpes 2021).

• **Abdoulaye SARR** (M2), 2020

Prediction of the composition of financial portfolios using a Machine Learning approach

(Supervisors: I. Girerd-Potin - CERAG, D. Georges, GIPSA-lab)

The internship was carried out during the year 2020 by Abdoulaye Sarr (M2 MIASHS), with Isabelle Girerd-Potin and Didier Georges as supervisors. The thesis was defended and validated the trainee's Master Degree.

In accordance with the objective, the trainee worked on different models and algorithms from Information Sciences and Automation to identify the composition of mutual fund portfolios from easily available and objective information, namely the profitability of these funds.

The internship has allowed the development of a thesis topic on the transparency of mutual funds management, which is financed by the AAP IRGA 2021 of the UGA. The thesis started at CERAG on 1/10/2021, co-supervised by I. Girerd-Potin and D. Georges.

• **Nina GUIGNIER** (L3), 2020

Supply and demand of wood building products for the private market.

(Supervisor: Y. Sieffert - 3SR / Co-fund VOR Platform)

21 companies in the wood industry were contacted to establish a picture of their activity.

- **Adeleye ADEDIRAN** (M2), 2021

IT/IS to prevent accidents and improve safety in maritime transportation
(Supervisors: F. Alberti- CERAG, C. Dominguez - IAE, F. Corset - LJK)
This internship allowed a literature review on the main causes of accidents in the maritime sector. A database was produced and a corpus was established from the accident reports. This has allowed us to extract information on the main causes of accidents. This database will be used to build a Bayesian network with the aim of preventing accidents and providing decision support to mariners. This study analyses accident reports from IMO Global Integrated Shipping Information System (GISIS), Marine Casualty Investigation Board (MCIB), European Maritime Safety Agency (EMSA), International Oil Pollution Compensation Funds (IOPC Funds), National Transportation Safety Board (NTSB), International Tanker Owners Pollution Federation Ltd (ITOPF) and Australian Transport Safety Bureau (ATSB) where primary causes of maritime transportation accidents were identified, leading to the proposition of risk modelling using Bayesian networks and other related models. Moreover, IT/IS solutions of artificial intelligence and machine learning that are rigid against cyber-attack are proposed in a bid to mitigate future accident occurrences across the ocean.

- **Pauline CHOLLIER** (M2), 2021

INCERTITUDES Rapport d'étude pour le groupe de travail I-RISK Indura, Inrae, 3SR, Geolithe, Parn [Study Reportfor the I-RISK Indura working Group]
(Supervisors: S. Lambert - INRAE/ETNA, J. Baroth - 3SR)
This internship constitutes an essential step towards the definition of research and development actions that meet the explicit or implicit expectations of the project owners concerned by natural mountain risk management operations. It has allowed, on the basis of the analysis of real cases, to define the root causes of failures in the operational management of natural hazards. The fruit of this work is sufficiently accomplished to allow a presentation to the entire rock risk community, during the 'Rock Slope Stability' conference on 17 and 18 November in Chambéry. It has also been the subject of a communication by the I-RISK collective (https://mcusercontent.com/3bb424b2725159691529388bc/files/be610e25-e9f5-797e-dcd3-3cbcaea37f56/NS_I_RISK_automne_hiver_2021.pdf).

- **Antonin MEJEAN** (M2), 2021

Analysis of the survey on the Beirut harbour explosion (4 August 2020).
What human behaviour in a sudden crisis situation?
(Supervisors: E. Beck - IUGA/PACTE)
The objective of this internship is to prepare the main statistical results of a survey co-constructed by the French team of the University of Grenoble Alpes on the reactions of the inhabitants during the explosion of August 4, 2020 in the port of Beirut. Beirut and its urban agglomeration are particularly concerned by the issue of seismic risk management. Nearly 40% of the population of Lebanon resides there and 98% of Beirut's territory is urbanised with a high vertical densification of residential towers and offices which rub shoulders with numerous old buildings of poor quality. These conditions highlight the high vulnerability of Beirut residents to earthquakes and the urgency of implementing effective protection and prevention policies, adapted to the Lebanese context.

- **Tristan MONTAGNON** (M2), 2021

Optical image correlation methods for sub-pixel spatial shifts estimation: A deep learning approach
(Supervisor: J. Hollingsworth - ISTerre)
The project allowed us to start a new collaboration between ISTere and GIPSA-Lab, and to explore new methodologies for image processing... in particular to see if we can exploit machine learning techniques to build a new type of 2D correlation approach for image correlation. We have secured funding at IRGA to develop the project into a PhD thesis for Tristan starting in October 2021.

- **Juliette VICENTE** (M2), 2021

Influence of crystallinity on eruptive dynamics. Contribution of numerical modelling.
(Supervisors: M. Collombet - ISTerre, A. Burgisser - ISTerre)
This work allowed us to build a first numerical model to calculate the influence of the crystal content on the gas loss of silica-rich magmas. This model then allowed us to test the capacity of gas evacuation but also to quantify gas fluxes at the surface in the case of 3 different volcanoes: Monsterrat (Lesser Antilles), Merapi (Indonesia) and Tungurahua (Ecuador). The very encouraging preliminary results led us to apply for a PhD funding on this topic. This ministerial funding was obtained and a student (Anna Theurel) is currently working on this promising subject in our team. Juliette honour another thesis proposal that in New Zealand.

Events & meetings 2018-2021

- 05/04/2018, **RISK Kickoff meeting**
- 15/06/2018, **Seminar interdisciplinarity**, Sandrine Caroly, Denis Jongmans
- 27/06/2018, **Prof H. KAWASE** (KYOTO university)
- 07/11/2018, **Prof P.PAULTRE** (Sherbrooke university)
- 08/11/2018, **Doctoral Kick Off Meeting**
- 07/12/2018, **International Advisory Board CDP Risk**, Maud Deves, Michel Jaboyedoff, Hiroshi Kawase
- 07/02/2019, **Seminar Resilience**, Céline Cholez et Didier Richard
- 21/02/2019, **Seminar Cascading effect** (Xavier Bodin & Christophe Prieur)

  . Alain BURGISSER et Jean VANDEMEULEBROUCK, *Cascading events in volcanology*
  . Sylvain DUPIRE, *Assessing wildfires effects on the protection capability of forests against rockfalls in the French Alps*
  . Philippe SCHOENEICH, *The complex process chain of the Tauredunum event*
  . Jean-Marc VENGEON et al., *Risques couplés: La prise en compte des couplages entre phénomènes naturels alpins et activités anthropiques. Études de cas (Séchilienne, ROGP, ILL)*
  . Jean-Marc TACNET et al., *Cascading effects in mountain critical infrastructures: application to road network and protection works management*
  . Caterina NEGULESCU et al., *Adjustability of exposed elements by updating their capacity for resistance after a damaging event: Application to an earthquake-tsunami cascade scenario.*

- 02/05/2019, **Grenoble Interdisciplinary Days**
- 09/05/2019, **WP 2 Kick-off Seminar** *Hazards and stakes: data collection, processing and modelling*, Xavier Bodin, Gregory Bievre et Gildas Besancon
- 11/06/2019, **WP1 Meeting** *Risk Management & Governance Modes*, Céline Cholez, Thierry Geoffroy, Jean-Marc Tacnet, Jeremy Eydieux.
- 3, 4 & 5/09/2019 **Summer Scool Cascarix**

  . Professor David Alexander (Institute for Risk and Disaster Reduction, University College London, UK). *Cascading Disasters: Lessons from the Past, Recent Developments and Prospects*
  . Giacomo Como (Politecnico di Torino, Italy) *Resilience of dynamical flow networks under cascading failure.*
  . Eric Chatelet (University of Troyes, France). *Domino Effect Analysis: Methods and Tools*
  . *Reflexive feedback on CDP Risk thesis topics on cascading effects and the case of Chambon Tunnel* (led by the PhD Students team and CDP researchers) with local actors (CEREMA, PARN)
  . François Daniellou (ICSI). *Addressing Safety Culture with all Stakeholders*.
  . Cecilia De La Garza (EDF). *The simulation of extreme situations for the analysis of resilience and reflections on new forms of preparedness for crisis management*
  . François Giannocccaro (Institut des risques majeurs). *Major risks (natural and technological) and "state" of potential interactions on industrial sites Seveso with high threshold in Rhone-Alps.* Return to work- 2012 IRMA
  . Serge Peruccio (Vencorex - Chemical Park in Pont de Claix). *Evaluation and risk management*.
  . Christophe Ferrari (Grenoble Alpes Metropole). *Resilience in Grenoble-Alpes Metropol territories space development*
  . Jérôme Fauconnier (Political representative of Trièv'sCommunity). *Landslide risk management in a rural area near an urban agglomeration: issues and challenges*
  . Roland Nussbaum (Association Mission des Risques Naturels). *How to insure cascading risks?*
  . Pascal Lacroix (ISTerre). *Effect of earthquakes on land movements and communities in the Colca Valley, Peru*
  . Julien Picard (Training Center Anesthesiology and Critical Care Medicine, Grenoble University Hospital). *Management of critical situations in Health: the place of simulation*.

- 15/10/2019, **Workshop Resilience** with Mika Shimizu (Kyoto University)
- 03/06/2020 **Séminar Resilience** *Les enseignements de l'accident de la navette Challenger pour la prise de décision dans les organisations,* Thomas Reverdy (Pacte)
- 26/06/2020, **Seminar** *Cross-disciplinary projects and researches on Disaster Risk Reduction in Nepal,* Philippe Garnier (AECC) & Santosh Yadav (3SR)
- 22/10/2020, **Webinar** *La photogrammétrie, technique de suivi des ouvrages et des terrains*, Diego Cusicanqui (doctorant CDP Risk, EDYTEM) et Xavier Bodin (Edytem), Webinar Indura. A revoir: https://vimeo.com/473376992

• 14/01/2021, **Séminar Resilience** *Analysis of National-Local Policy Processes and Governance under Uncertainties for the Covid-19 Pandemic: Lessons Learned*, Céline Cholez (Pacte, UGA), Mika Shimizu (Kyoto University), Hamilton Bean (Denver Colorado University), 39 participants

• 7 & 8/04/2021, **Spring School Simulation & Crisis management**

. Marc Vuillet, Ecole d'Ingénieur de la Ville de Paris, *Résilience urbaine aux inondations. Projet de recherche RGC4 sur la gestion de crise inondation à la ville de Paris et la simulation multi-agents*
. Elise Beck (Laboratoire PACTE, Université Grenoble Alpes - UGA), *« Sain et sauf ? » Un outil immersif pour sensibiliser et évaluer l'impact de l'information préventive sur les risques naturels,* 66 participants
. Bruno Ciry (Préfecture de l'Isère), *Exercices réels de simulation de crise*
. Christelle Casse (Université de Lyon 2), *Méthodes ergonomiques pour simuler une situation de crise*
. Odile Plattard (Laboratoire Pacte, UGA), *Simulation model STEP (Earthquake Tsunami Evacuation*)
. Julie Dugdale (LIG/UGA), Elise Beck (Pacte/UGA) and Carole Adam (LIG/UGA), *Multi-agent simulation approach in crisis management*
. Mina Alipour, PhD students of the Cross Disciplinary Project RISK – LIG, *Simulation objects, the serious game to help in emergency management*,
. Rouba Iskandar PhD students of the Cross Disciplinary Project RISK – ISTerre, *Simulation of seismic crisis, adoption of behaviour according to vulnerable factors, informing the population in advance, testing crisis scenarios*
. Avalanche exercise, full-scale simulation, presentation of the self-confrontation methodology to improve the collective work and produce knowledge on the material and technical needs supporting the coordination
. Aurélie Peillon, PhD students of the Cross Disciplinary Project RISK – Pacte,

• 07/05/2021, **Webinar** *Perception des risques et prévention*, par Rémi Kouabenan Laboratoire Inter-universitaire de psychologie (LIP/PC2S) UGA, 100 participants

• 16/06/2021, **Conférence recherche RSE**, **Résilience des socio-écosystèmes dans un contexte de changement global,** avec Sandrine Anquetin (IGE, CDP Trajectories), Nicolas Buclet (PACTE, CDP Trajectories), Céline Cholez (PACTE, CDP Risk), Didier Georges (GIPSA-lab, CDP Risk).

• 21/06/2021, **Series of short webinars CDP Risk #1** *Multicriteria decision support in a context of imperfect information for the management and assessment of natural risks,* par Jean-Marc Tacnet, ETNA, INRAE Grenoble, 51 participants.

• 14 & 15/10/2021, **Worskshops** *Simulation & Crisis management*

. Franck Bourrier, Dominique Daudon (3SR Laboratory, UGA), *Exercise on rock risk*
. Guilhem Dupuis (IRMa), *EXOCRISE PCS - Grenoble Institute of Major Risks*
. Jean-Marc Tacnet (INRAE-ETNA), *DECISION TRACE - INRAE: avalanche simulation role play*

• 03/12/2021 **Project Closure and Scientific Advisory Board**

• 10/12/2021 **Webinar Rohit Jigyasu, (ICCROM),** *Climate Change and Disaster Risk Management*

• 14/12/2021 **Seminar** *Exceptionnal Risk and Resilience*

• 4 & 5/05/2022, **60th ESREDA Seminar,** *Resilience Engineering and Modelling of Networked Infrastructures,* Organization: Ch. Bérenguer (GIPSA-lab), O. Gaudoin (LJK)

Publications 2018-2021

Publications 2018

Alfieri, E., Burlacu, R., Enjolras, G., On the nature and financial performance of Bitcoin	*Journal of Risk Finance*
Bañgate,J., Dugdale, J., Beck, El., Adam, C., A Multi-agent System Approach in Evaluating Human Spatio-temporal Vulnerability to Seismic Risk using Social Attachment	*In Risk Analysis XI. WIT Transactions on Engineering Sciences. WIT Press. Vol. 121, 2018. Eds. C.A. Brebbia and A. Fabbri.*
Bellier, J., Zin, I., Bontron, G., Generating coherent ensemble forecasts after hydrological postprocessing: Adaptations of ECC based methods	*Water Resources Research, 54(8), 5741-5762 (DOI: 10.1029/2018WR022601)*
Benjelloun, Y., de Sigoyer, J., Dessales, H., Garambois, S., Şahin, M., Construction history of the aqueduct of Nicaea (Iznik, NW Turkey) and its on-fault deformation viewed from archaeological and geophysical investigations	*Journal of Archeological Science.21 p 389-400.*
Crété, E., Yadav, S., Sieffert, Y., Hajmirbaba, M., Hosta, J., Mendes, M., Moles, O., Shrestha, P.,Garnier, Ph., Promoting Vernacular Architecture, A Basis for Building Back Safer? A Case Study from Nepal	*R. Aguilar et al. (Eds.): Structural Analysis of Historical Constructions, RILEM Book series 18, 11-13 September 2018, Cusco, Peru, pp 2457-2465*
Daouia, A., Girard, S. and Stupfler, G., Estimation of Tail Risk based on Extreme Expectiles	*Journal of the Royal Statistical Society: Series B, Royal Statistical Society, 2018, 80 (2), pp.263-292*
El Methni, J., Gardes, L., Girard, S., Kernel estimation of extreme regression risk measures	*Electronic Journal of Statistics*
Fritsch, E., Sieffert, Y., Algusab, H., Grange, S., Garnier, Ph., Daudeville, L., Numerical analysis on seismic resistance of a two-story timber-framed structure with stone and earth infill	*International Journal of Architectural Heritage*
Ghazi, S., Dugdale, J., Khadir, T., A Multi-Agent based Approach for Simulating the Impact of Human Behaviours on Air Pollution	Informatica, *An International Journal of Computing and Informatics. Vol. 42, No.2.*
Norris, A., Gonzalez, J., Parry, D., Scott, R., Dugdale, J., Khazanchi, D., The Role of e-Health in Disasters: A Strategy for Education, Training and Integration in Disaster Medicine	*Journal of the International Society for Telemedicine and eHealth. Vol.6 (2018)*
Yadav, S., Sieffert, Y., Crété, E., Vieux-Champagne, F., Garnier, Ph., Mechanical behaviour of different type of shear band connections being used in reconstruction housing in Nepal	*Construction and Building Materials, Elsevier, 2018, 174, pp.701-712*

Publications 2019

Adam, C., Bailly, Ch., Dugdale, J. Communication During Bushfires, Towards a Serious Game for a Serious Matter. International Journal of Information Systems for Crisis Response and Management (IJISCRAM). Vol. 10, Issue 2. 2019.	International Journal of Information Systems for Crisis Response and Management
Bañgate J., Dugdale J., Beck E., Adam C., 2019 : Review of agent based modelling of social attachment in crisis situations. International Journal of Information Systems for Crisis Response and Management. 11 (1) : 34-65.	International Journal of Information Systems for Crisis Response and Management
Bangate, J., Dugdale, J., Beck, El., Adam, C,. Review of Agent Based Modelling of Social Attachment in Crisis Situations. International Journal of Information Systems for Crisis Response and Management. 2019 Vol. 11. Issue 1.	International Journal of Information Systems for Crisis Response and Management
Beutner, E., Bordes, L., Doyen, G., « Consistent semiparametric estimators for recurrent event times models with application to virtual age models », Bernoulli 26 (1), 557-586, 2019.	Bernoulli 26
Cholez, C. and Trompette, P. (2019), 'Designing Infrastructure for The Poor: Transactions Within Unstable Ecologies' Thinking Infrastructures, ED. Series Research in the Sociology of Organizations, M. Kornberger, G. Bowker, N. Pollock, P. Miller, A. Mennicken, J.R. Nucho, J. Elyachar, Emerald Publishing.	Sociology of Organizations
Crete, E., Yadav, S., Sieffert, Y., Hajmirbaba, M., Hosta, J., Mendes, M. F., Garnier, P. (2019). Promoting Vernacular Architecture, A Basis for Building Back Safer? A Case Study from Nepal. In A. R; (Ed.), Structural Analysis of Historical Constructions (Vol. 18, pp. 2457–2465). Cusco, Peru: Springer. https://doi.org/10.1007/978-3-319-99441-3	Structural Analysis of Historical Constructions
Daouia, A., Girard , S. & Stupfler, G., "Extreme M-quantiles as risk measures: From L1 to Lp optimization"	Bernoulli
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