ISTerre
Institut des Sciences de la Terre

Géophysique
des Risques sismiques
Et gravitaires

Géophysique des **R**isques sismiques **E**t gravitaires

Geophysics of Seismic and Landslide Risks

2015	**Géophysique des Risques *et de l'Environnement***	**2020**	**Géophysiques des Risques sismiques Et gravitaires**	**2024**
Eric Larose & Cécile Cornou		Emmanuel Chaljub & Grégory Bièvre		

Laboratoire rattaché à l'OSUG

Team members

Rank	UGA	CNAP	**IRD**	**IFSTTAR**	CNRS	Academy	**Industry**
A	2	0	1	1	0	4 (4)	
B	1	2	3	2	0	8 (2)	2 (1)
Full time research	1.5	1	**4**	**3***	0	**9.5**	**0.5**

14 researchers
7 HDR (50%)
10 full-time research
11 PhD, 1 postdoc

- **2** associate researchers from industry (CEA Cadarache, Géolithe)
- **8** researchers from other teams (2 Failles, 2 Ondes, 3 Cycles, 1 TRB)
- 2015-2019 : 26 defended PhDs + **11** ongoing
- 2015-2019 : 6 completed post-docs + **1** ongoing

OUT: E Larose → Failles; *PY Bard*; *D Jongmans*

IN: **SR Kotha**

2019 — 2020 — 2024

GRE's DNA

From hazards to risks

Physicals models to assess hazards

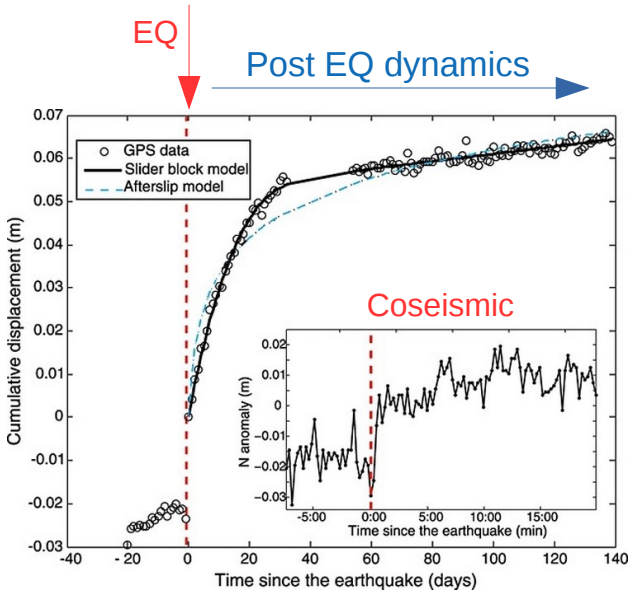
- Landslide dynamics.
- Earthquake Ground Motion.

Integration into risk studies

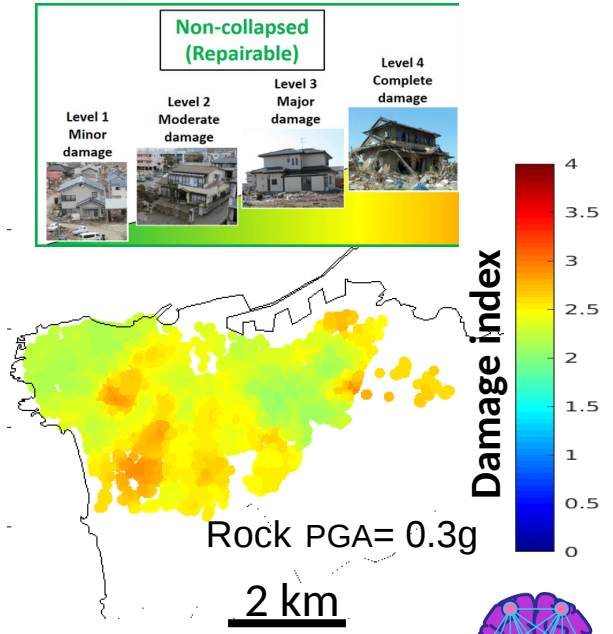
- Geophysical precursors to forecast landslides.
- Physics-based proxies & metamodels.
- New risk indices.

Our approach

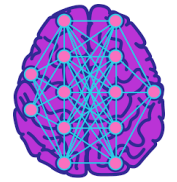
- Geophysical methods (imaging, monitoring).
- Observation: remote sensing & in-situ instrumentation, short & long-term acquisition.
- Lab experiments, numerical simulation, AI tools.



Maca, Peru: Earthquake triggered landslide



Beirut: Earthquake damage prediction



Community services

GProGe

Université Grenoble Alpes master

EOPSY

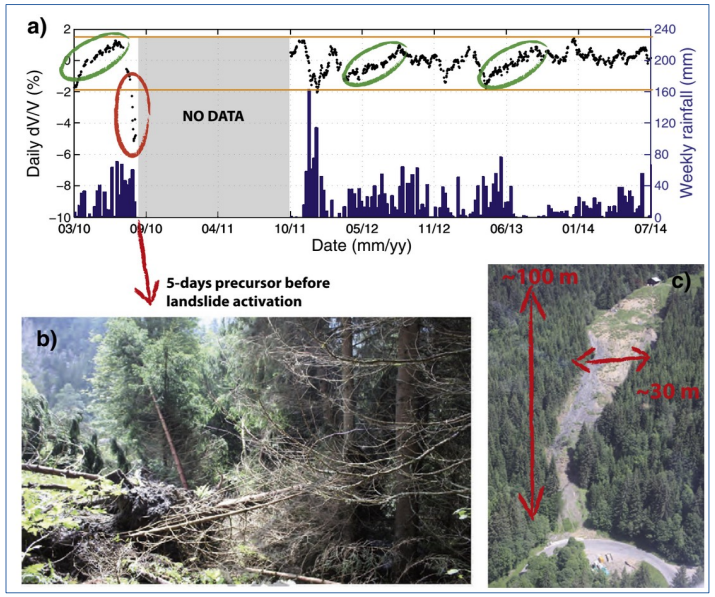
RAP Réseau Accélérométrique Permanent

OMIV Observatoire Multidisciplinaire des Instabilités de Versant

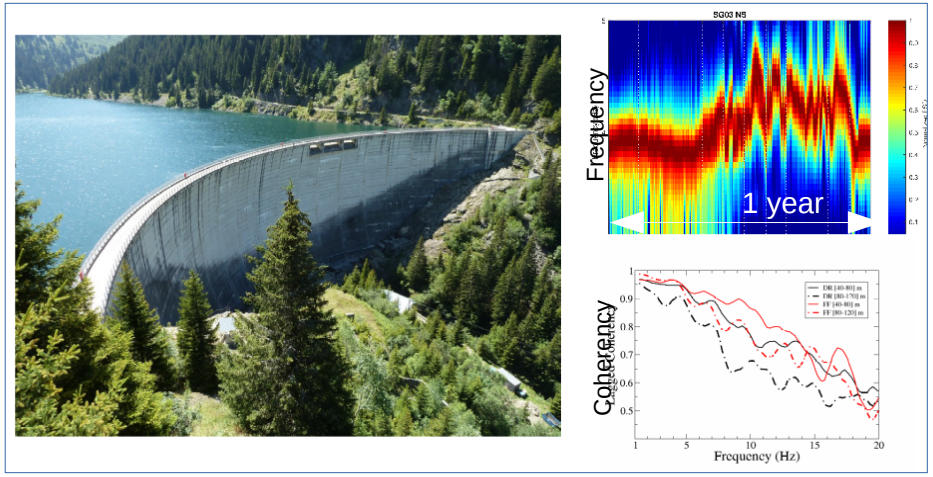
EPOS EUROPEANPLATEOBSERVINGSYSTEM

RESIF

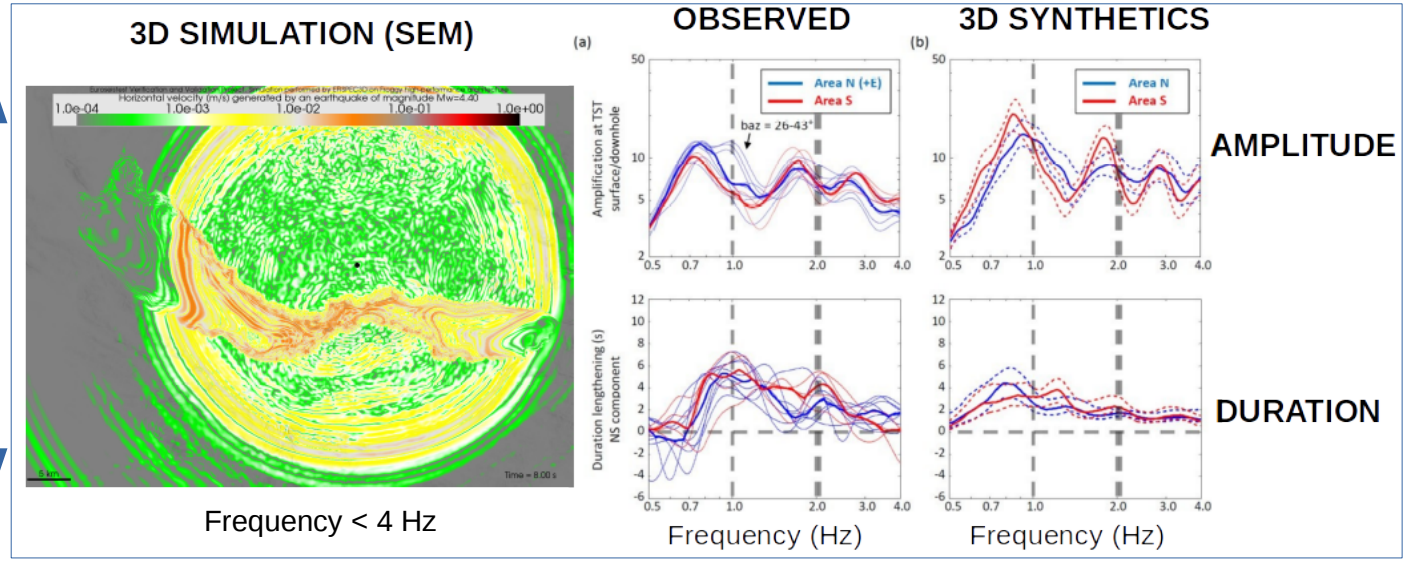
GRICAD Grenoble Alpes Recherche Infrastructure de Calcul Intensif et de Données



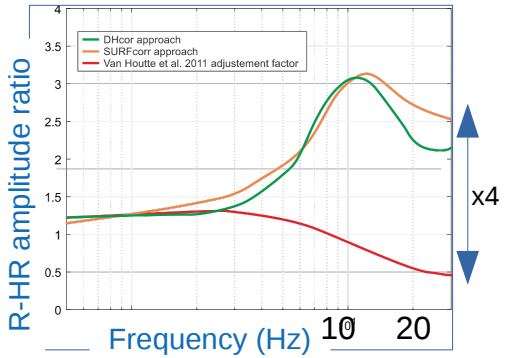
1 Ambient noise monitoring of landslide dynamics (Larose et al. **2015**).



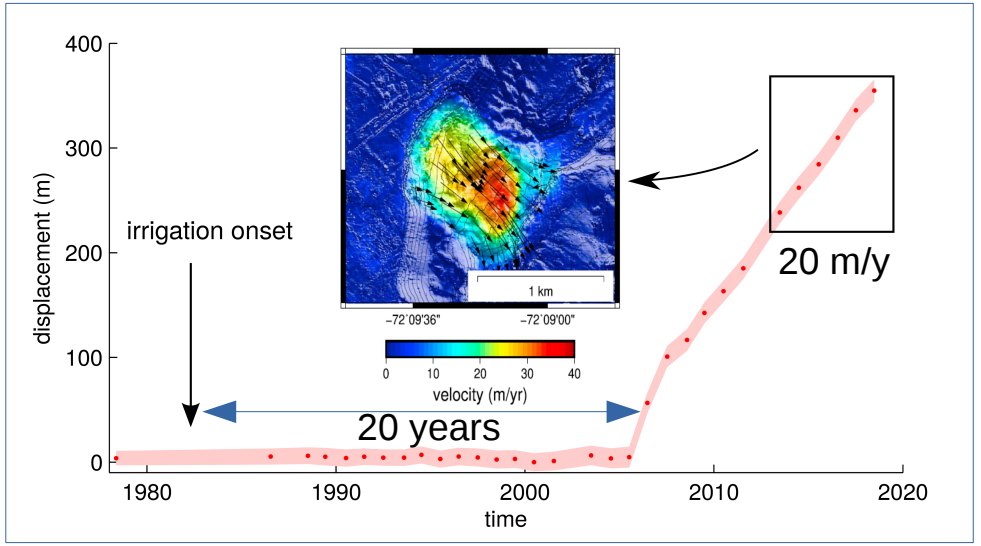
2 Earthquake and noise response of an arch dam (Koufoudi et al. **2017, 2018**).



3 Source-dependent amplification and lengthening of EGM (Maufroy et al. **2017**)



4 Host-to-target methods for hard-rock HF EGM (Bard et al. **2019**)



5 Irrigation triggered 12 massive landslides in Peru (Lacroix et al. **2019**)

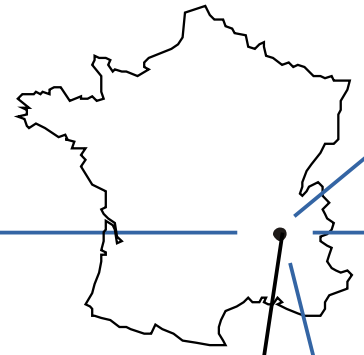
Recent results

Ongoing projects & networks

Earthquakes
Landslides
Mixed

2020 ANR DARE ANR MONIDAS POIA MLA3 2024

ANR EXAMIN
ANR SINAPS@
POIA SIMOTER LabEx OSUG@2020



SERA

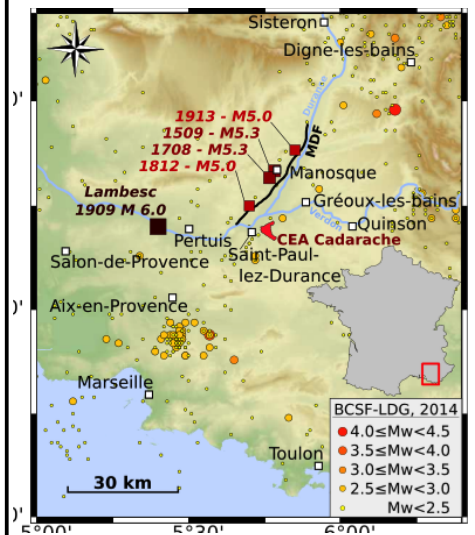
Peru
1 PhD

Iran / RTI TRIGGER
3 PhD

CEA / 1 PhD
LabCom Geo3ilab
CDP Risk / 3 PhD

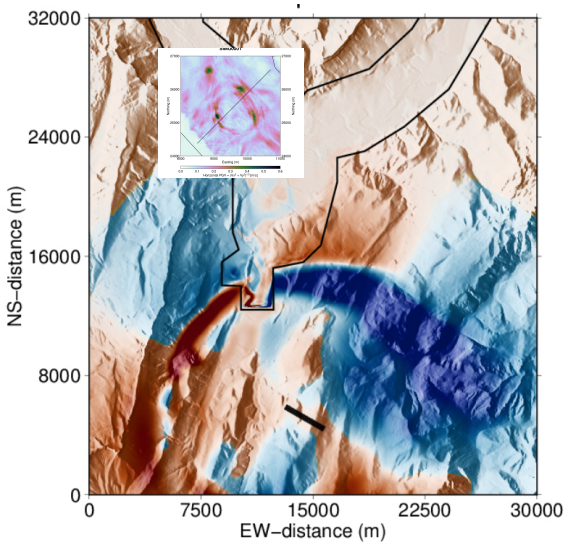
Lebanon / GRDI OLIFE
3 PhD

Scenario-oriented
EGM prediction
moderate seismicity



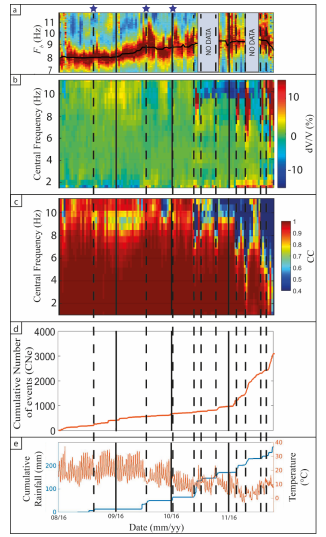
SINAPS@

Physics-based prediction
EGM spatial variability
from small-scale geology



EXAMIN

Asynchroneous
geophysical
precursors to
rock fall
PhD S. Fiolleau



OSUG@2020

Perspectives

2020

ANR DARE
ANR MONIDAS
CNES-AALPES
POIA MLA3, IDEX-RESOLVE

ANR ARGO-Q
ANR HARAVI
ITN REVUE

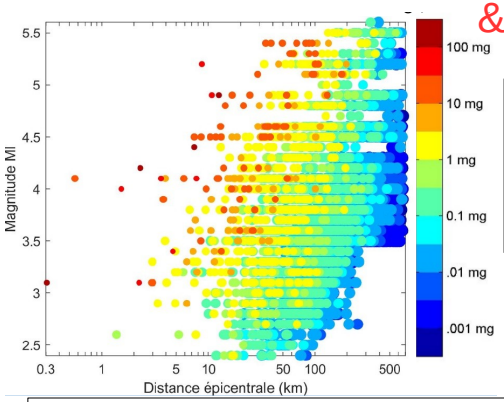
2024

Earthquakes
Landslides
Mixed

Submitted

1 DATA

Data-driven predictions
& forecasting



20 years of RESIF-RAP data +
PhysAdj 2017
site conditions

SR Kotha

Explore uncertainties (GMM,PSHA)

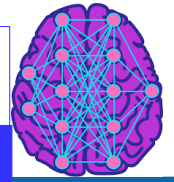
10 years of data

OMIV landslide instrumentation
Forcings and rheology dynamics
Need to attract new researchers

with Failles

Exploit HF Satellite Images DataBank
Slow dynamics landslides, precursors

with Cycles



Perspectives

2020 — 2024

ANR DARE
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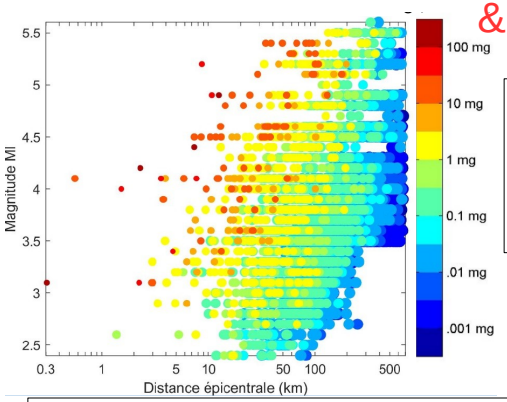

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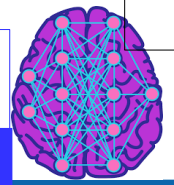
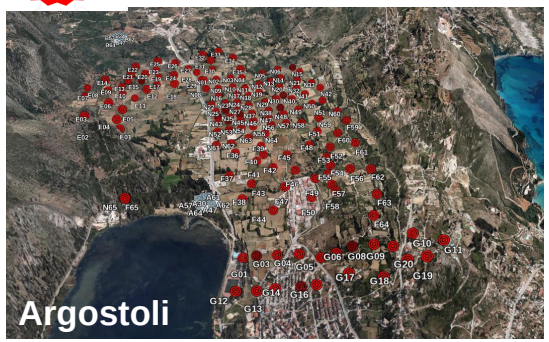


with Cycles

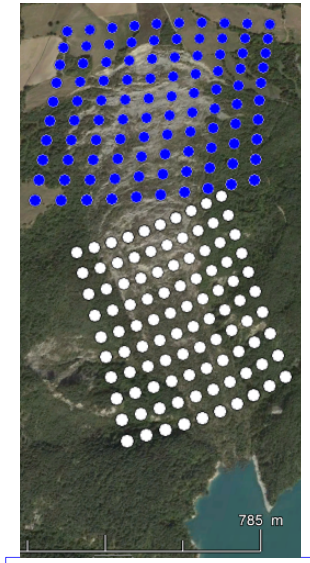
2 NEW DATA

Higher resolution observations (nodes + Optic Fiber DAS)



Record EGM @ damage scale
From waveforms to wavefields
From noise to EQ

Physics based inputs for:
Engineering needs,
Crisis dynamics



Damage localization
Deformation mechanisms (slide, flow)

RESOLVE, MONIDAS

with Ondes

Perspectives

2020

ANR DARE
ANR MONIDAS
CNES-AALPES
POIA MLA3, IDEX-RESOLVE

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Earthquakes
Landslides
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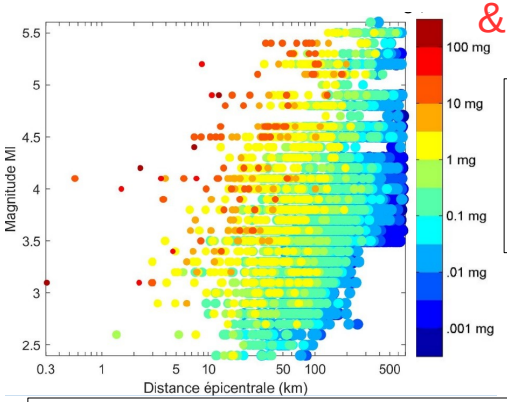

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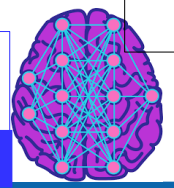

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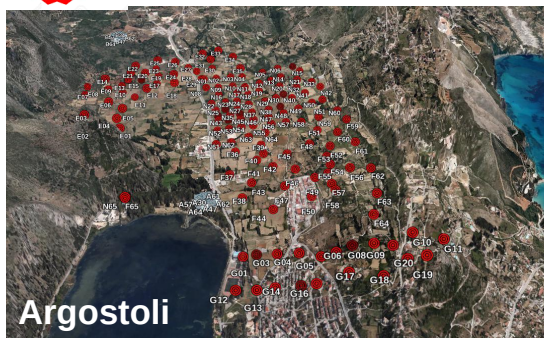

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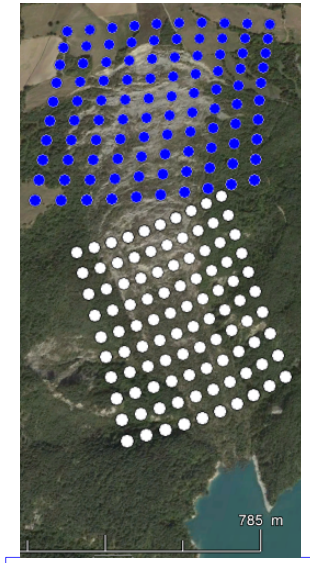

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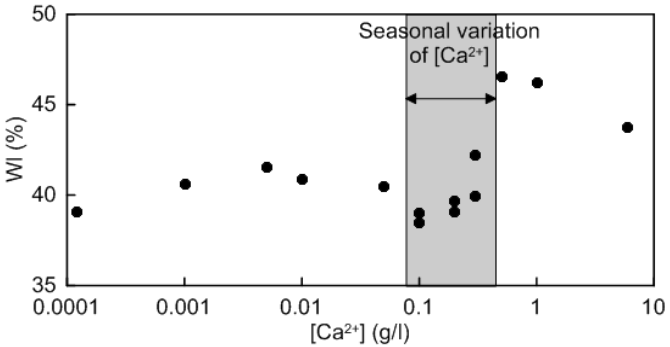
RESOLVE, MONIDAS

with Ondes

3 PROCESSES

Gain physical insight



Chemical control of Fluidization

HARAVI with Geochemistry & Mineralogy

EGM: Attenuation and NL effects

ARGO-Q, DARE with Ondes

Landslides forcings
Short Vs long-term (10 ky) dynamics

AALPES with TRB

HCERES
26-27 November 2019

SWOT analysis

- Strengths range and complementarity of expertises and skills; fundamental and societal research; collaborative spirit.
- Weaknesses seismic and landslide hazards covered by several teams; no project P.I.s at national/european level, no CNRS members.
- Opportunities transverse axes at ISTerre to help the structuration of hazard studies; computing group (calcul@ISTerre) to support our needs; Risk Institute + EUR Risk.
- Threats retirement of senior researchers; erosion of team's landslide taskforce; end of MEEES.