

OO ENGINE RISK: PAST, PRESENT AND FUTURE

VITOR SILVA, ON BEHALF OF MANY MANY PEOPLE



working together
to assess risk

GEM
GLOBAL EARTHQUAKE MODEL

OO
OPENQUAKE

Once upon a time in town far far away...



... the first OpenQuake commit was merged.



WE STARTED IN 2010, BUT NOT REALLY...



2010

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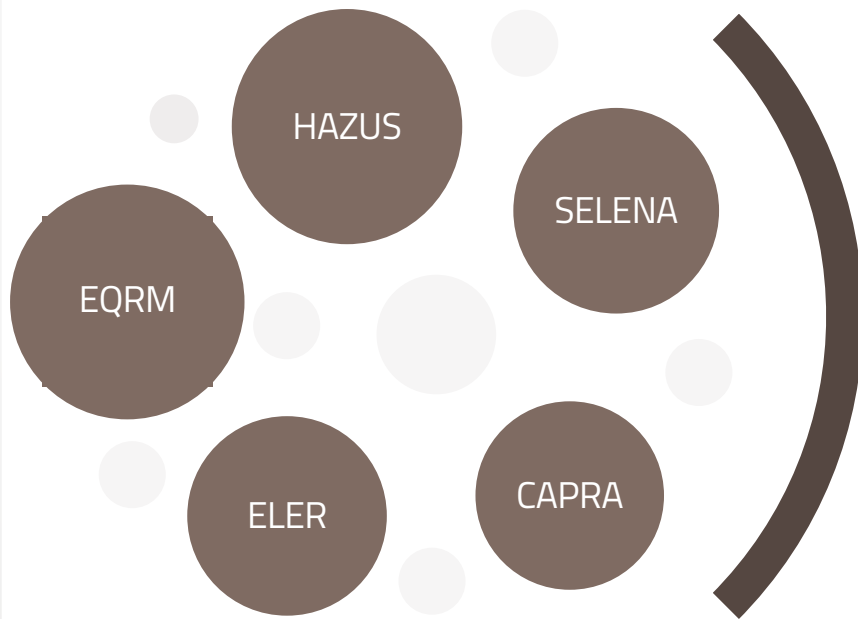
2017

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2019

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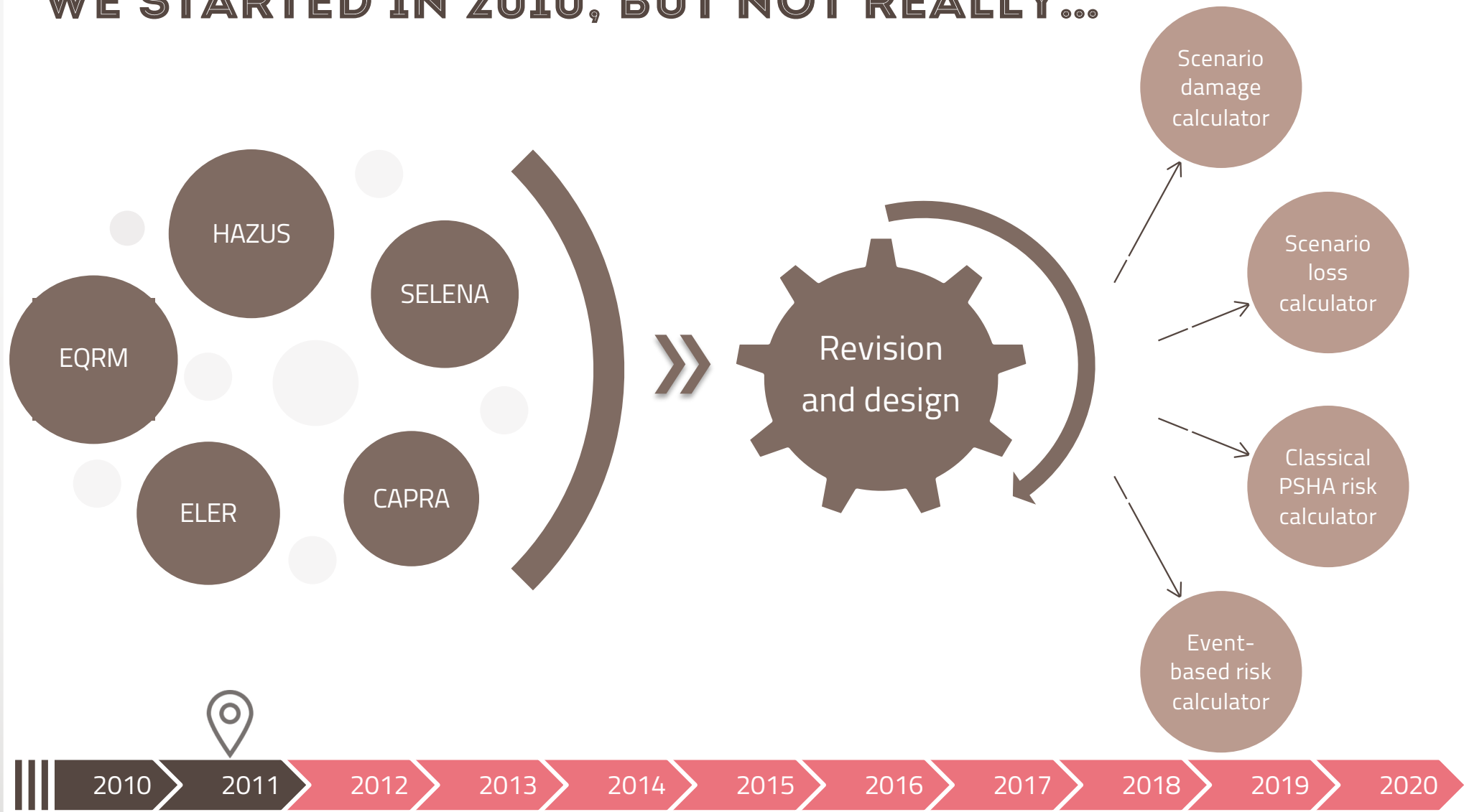
2017

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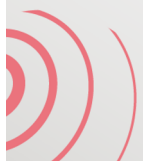
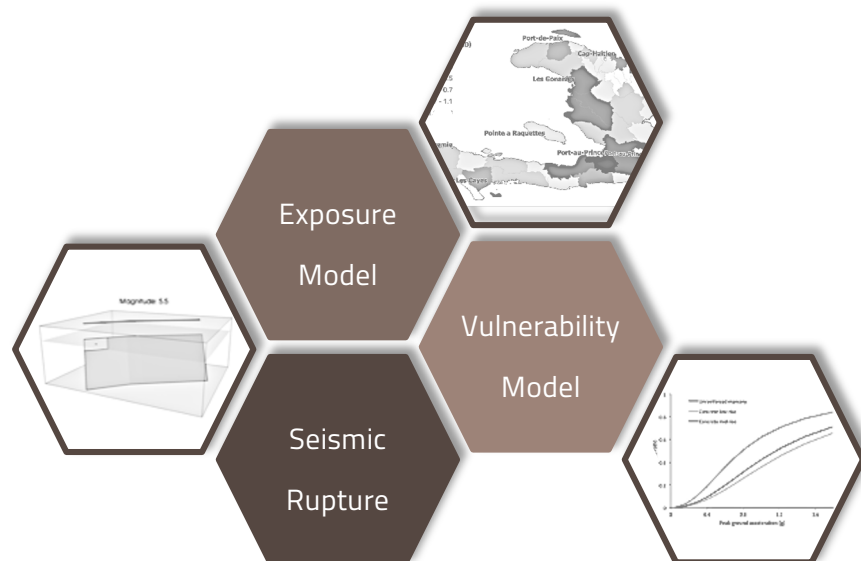
2019

2020

WE STARTED IN 2010, BUT NOT REALLY...



SCENARIO LOSS CALCULATOR



SCENARIO LOSS CALCULATOR



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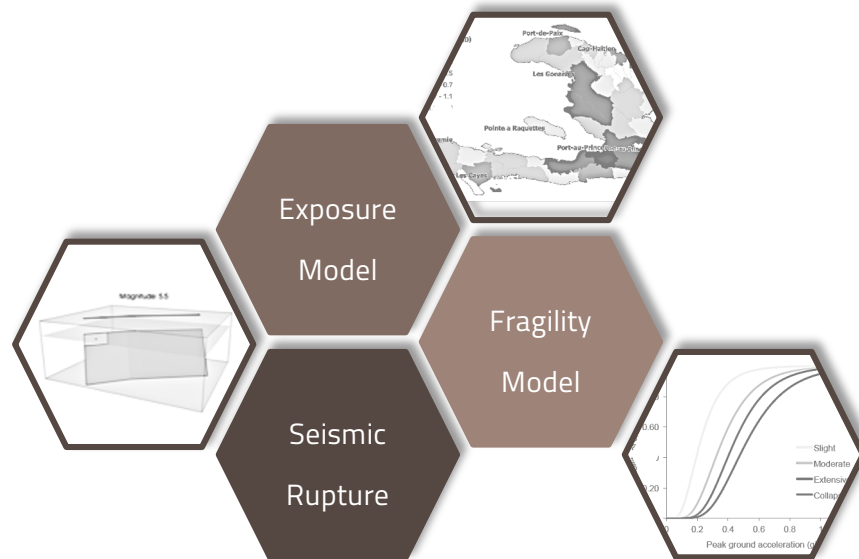
2017

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SCENARIO DAMAGE CALCULATOR



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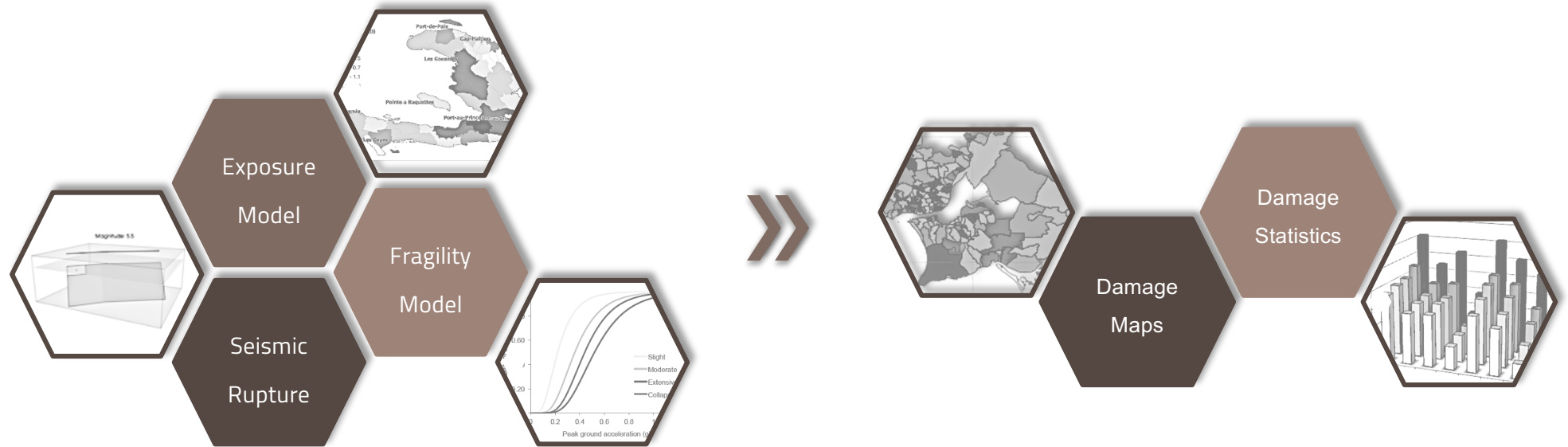
2017

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SCENARIO DAMAGE CALCULATOR

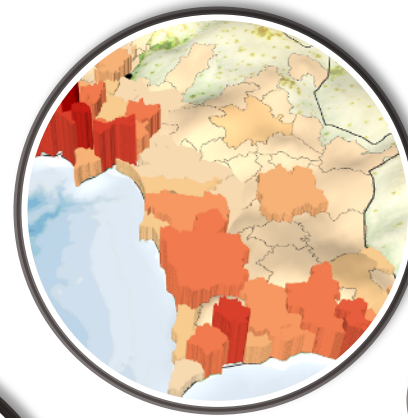


APPLICATIONS OF THE SCENARIO CALCULATORS

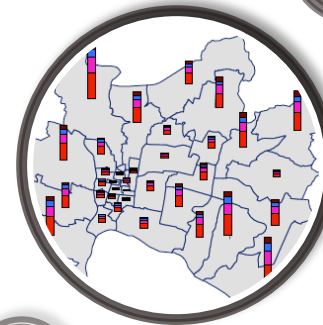
Loss assessment for
schools in Basel
Michel et al.



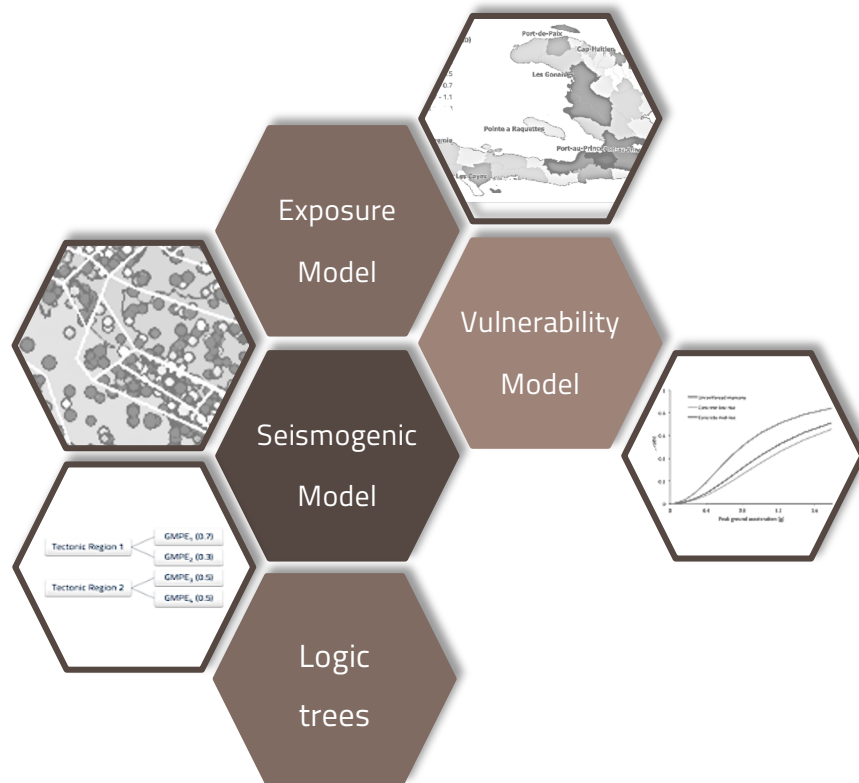
Damage assessment in Portugal
Silva et al.



Earthquake loss assessment in Nepal
Chaulagain et al.



CLASSICAL PSHA RISK CALCULATOR



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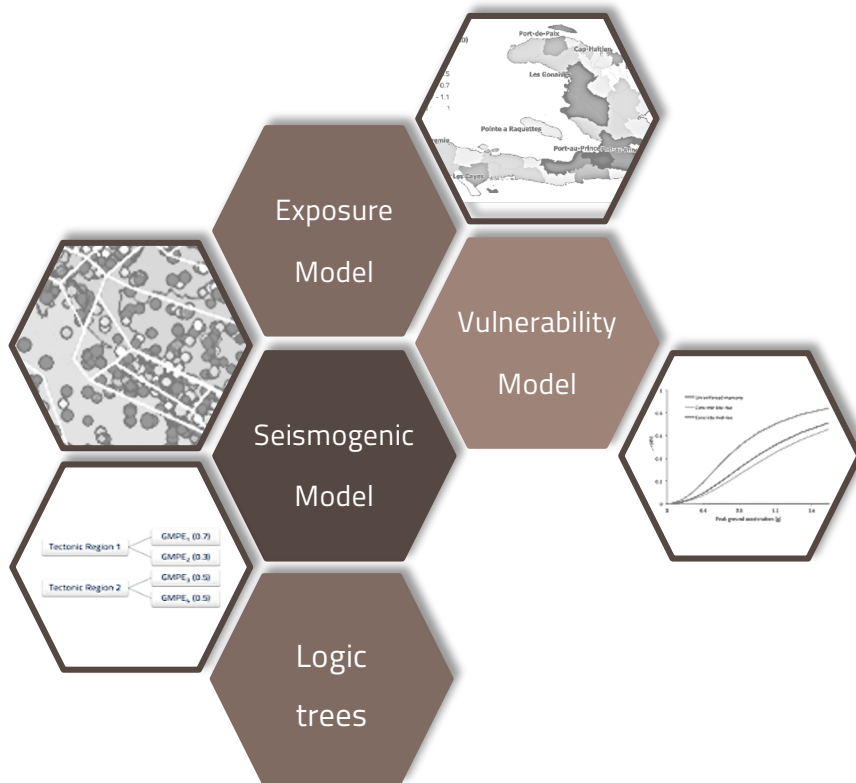
2019

2020

CLASSICAL PSHA RISK CALCULATOR



EVENT-BASED RISK CALCULATOR



EVENT-BASED RISK CALCULATOR



2010

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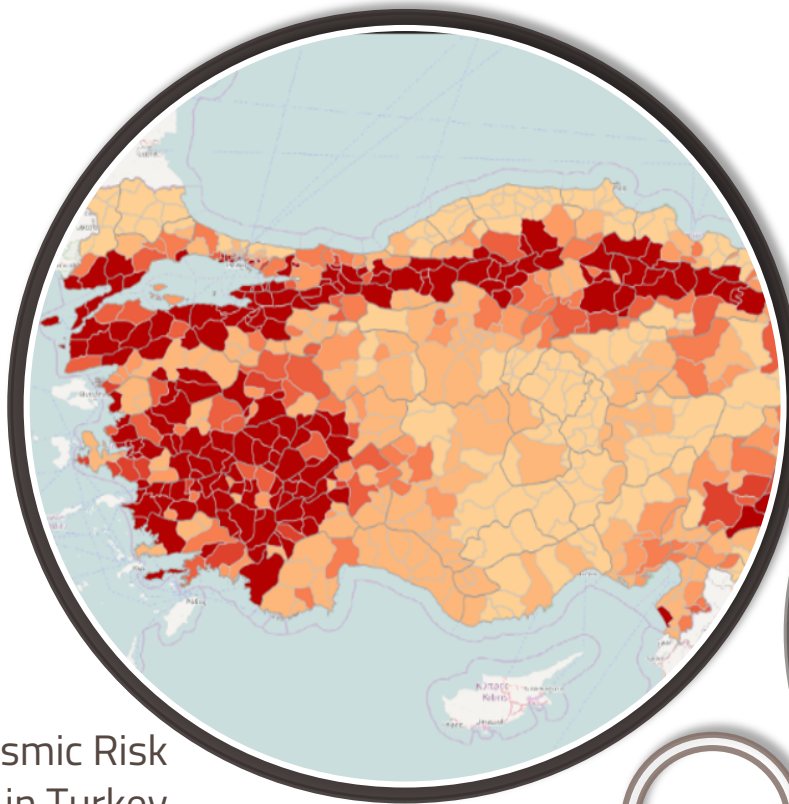
2017

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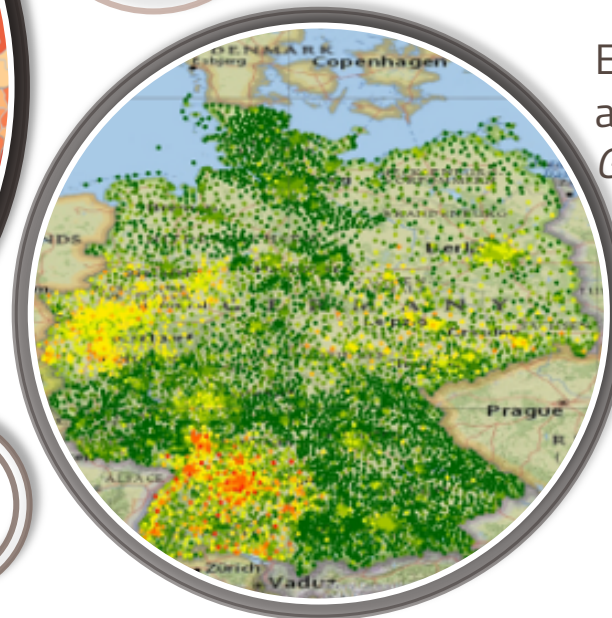
2019

2020

APPLICATIONS OF THE PROBABILISTIC CALCULATORS



Seismic Risk
Assessment in Turkey
Ozcebe et al.



Event-based risk
assessment for Europe
GEM partners

IMPROVING OPENQUAKE'S RISK INPUT/OUTPUTS

INPUT PREPARATION TOOLKIT

Exposure Fragility Consequence Vulnerability Earthquake Rupture Configuration

Magnitude (Mw):

Risk (logarithm):

Hypocenter:

Longitude (degrees):

Latitude (degrees):

Depth (km):

Development of the web-based Input Preparation Toolkit (IPT)



Extension of the Classical PSHA-Risk calculator to consider damage

5.50E+00	2.66E+01	3.99E+01	1.93E+06	9.64E+05
5.50E+00	2.66E+01	3.99E+01	1.81E+06	9.06E+05
5.50E+00	2.78E+01	4.04E+01	1.18E+06	5.91E+05
5.50E+00	2.78E+01	4.04E+01	1.01E+06	5.07E+05
5.50E+00	2.78E+01	4.04E+01	8.99E+05	4.50E+05
5.50E+00	2.78E+01	4.04E+01	5.87E+05	2.93E+05
5.50E+00	2.66E+01	3.99E+01	2.47E+05	1.23E+05
5.50E+00	2.78E+01	4.04E+01	8.63E+05	4.32E+05
5.50E+00	2.78E+01	4.04E+01	8.35E+05	4.1E+05
5.50E+00	2.78E+01	4.04E+01	6.66E+05	3.3E+05
5.50E+00	2.78E+01	4.04E+01	6.64E+05	3.2E+05

Possibility to disaggregate the event loss table per individual asset

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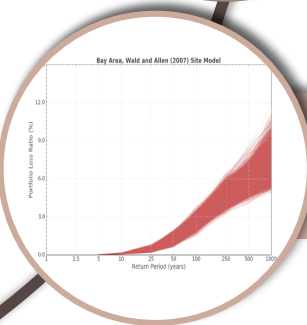
IMPROVING THE COMPUTATIONAL PERFORMANCE



Development of the QGIS OpenQuake plug in for output visualization



Important improvement of the computational performance



Capability to handle models with thousands of logic tree branches



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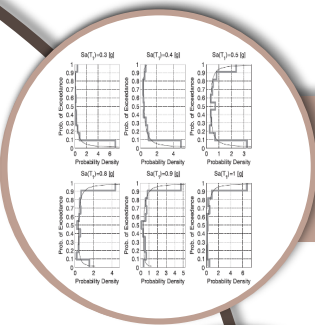
2017

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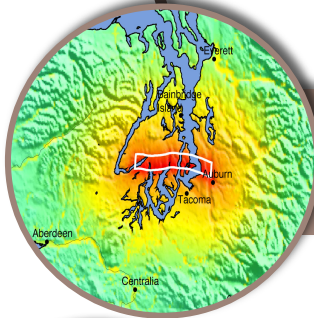
2019

2020

VERIFICATION, VALIDATION AND CALIBRATION!



Improvement of uncertainty modelling in vulnerability with PMFs



Implementation of compatibility with USGS-PAGER ShakeMaps

Occupancy	Province	Country	Number of Buildings	Occupants (thousands)	Occupants (thousands)	Occupants (thousands)	Occupants (thousands)	Occupants (thousands)
CA	CA	USA	173,820	1,488,113	137,211	213,200	15,281,158	15,281,158
HI	HI	USA	45,418	41,130	30,718	75,330	13,286,962	13,286,962
IL	IL	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
IN	IN	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
MI	MI	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
NY	NY	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
OH	OH	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
PA	PA	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
VA	VA	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
WI	WI	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
WV	WV	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
KY	KY	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
TN	TN	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
MS	MS	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
AL	AL	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
GA	GA	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
SC	SC	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
NC	NC	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
MD	MD	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
DE	DE	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
NJ	NJ	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
CT	CT	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
RI	RI	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
MA	MA	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
VT	VT	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
NH	NH	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148
ME	ME	USA	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148	1,148,148

Introduction of tags in the exposure model to allow loss aggregation



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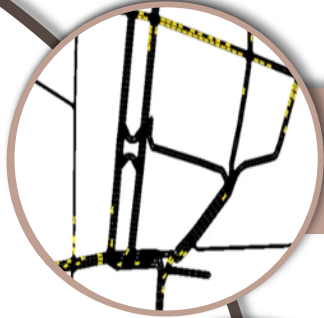
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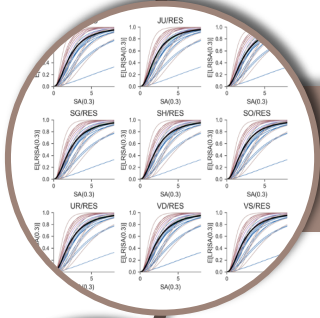
2019

2020

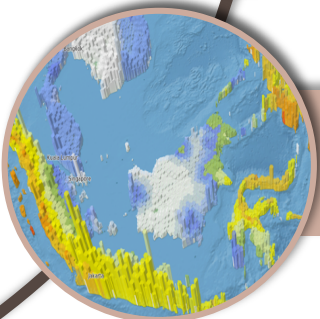
PUSHING OPENQUAKE TO ITS LIMITS AND BEYOND



Possibility to export damage realizations per seismic event



Introduction of logic trees in the vulnerability component



Performance improvements to handle global seismic risk calculations



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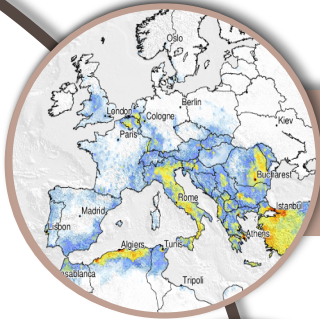
2017

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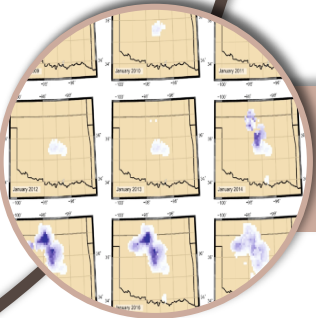
EXPANDING THE APPLICATION OF OPENQUAKE



Improvement of calculations and performance at the continental scale



Assessment of losses and damage due to volcanic hazard



Employment of OpenQuake in loss estimation due to induced seismicity



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RESPONDING TO EMERGING GAPS AND CHALLENGES

Impact of earthquakes
in the current pandemic

Dynamic risk and
machine learning

Risk assessment due
to secondary perils

2010

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2017

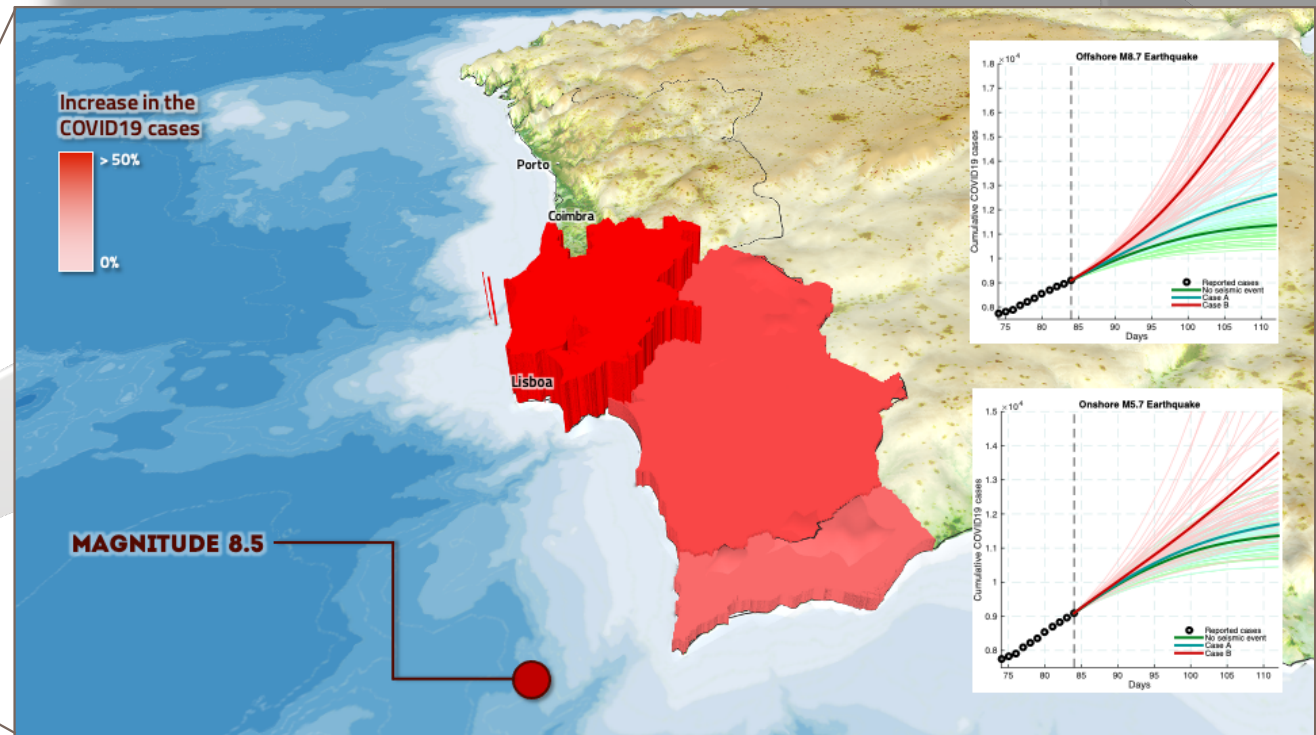
2018

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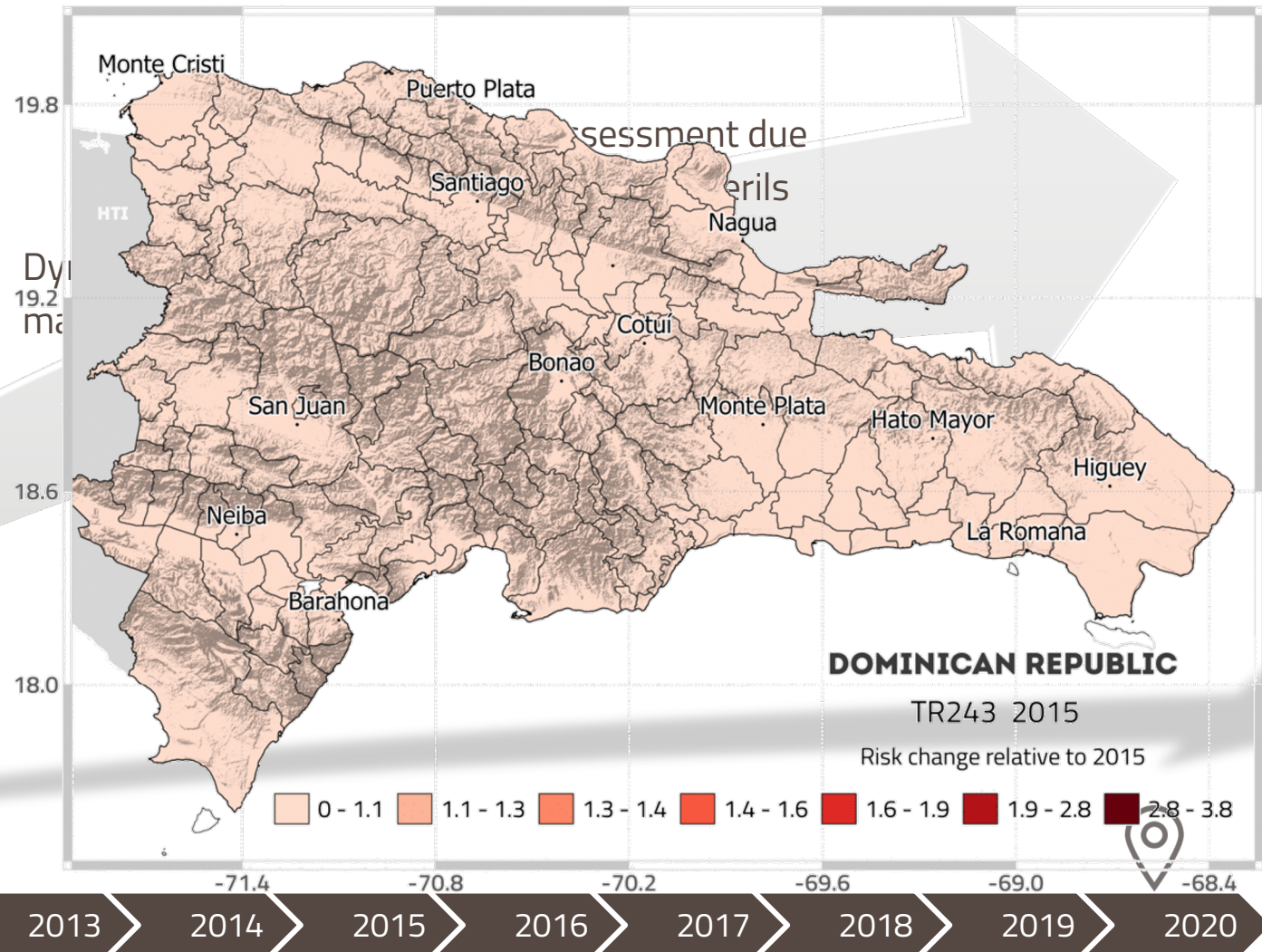
RESPONDING TO EMERGING GAPS AND CHALLENGES

Impact of earthquakes
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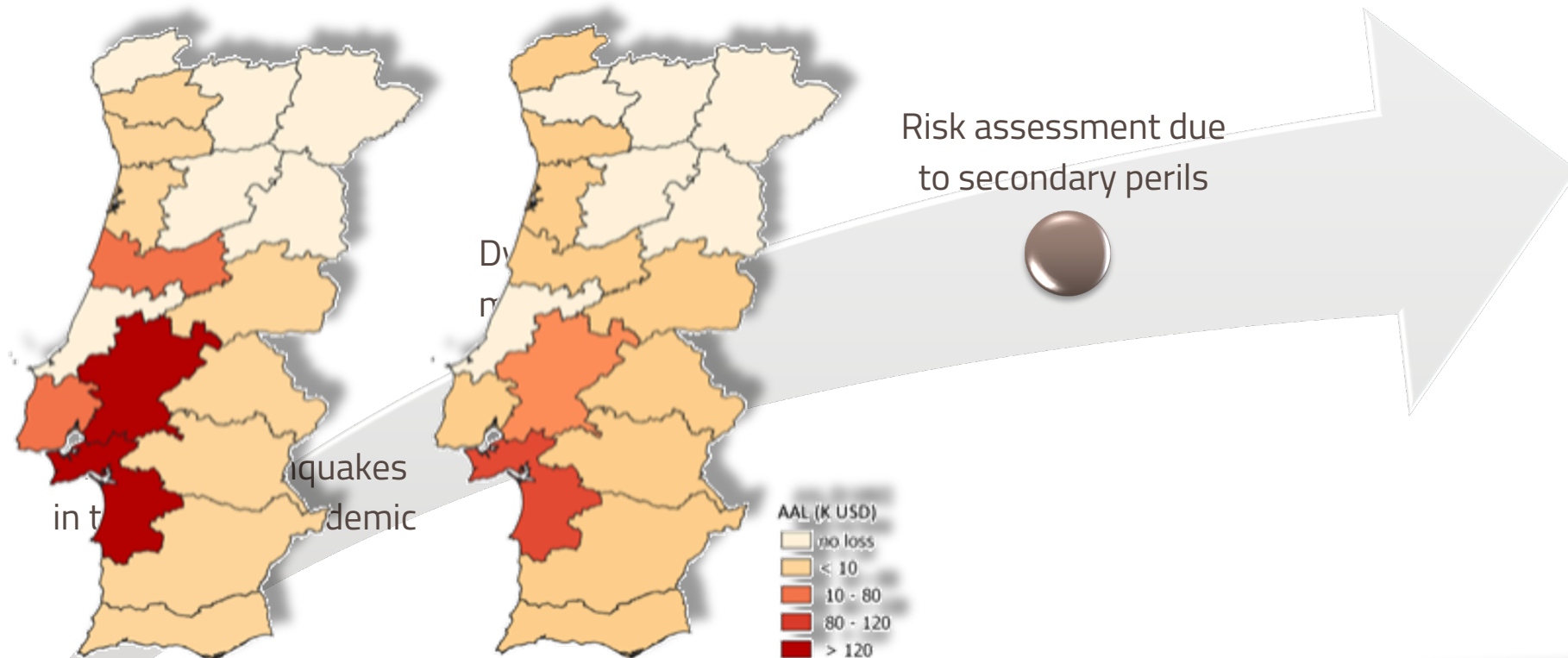


RESPONDING TO EMERGING GAPS AND CHALLENGES

Impact of earthquakes
in the current pandemic



RESPONDING TO EMERGING GAPS AND CHALLENGES



Average annual losses due to two liquefaction models

2010

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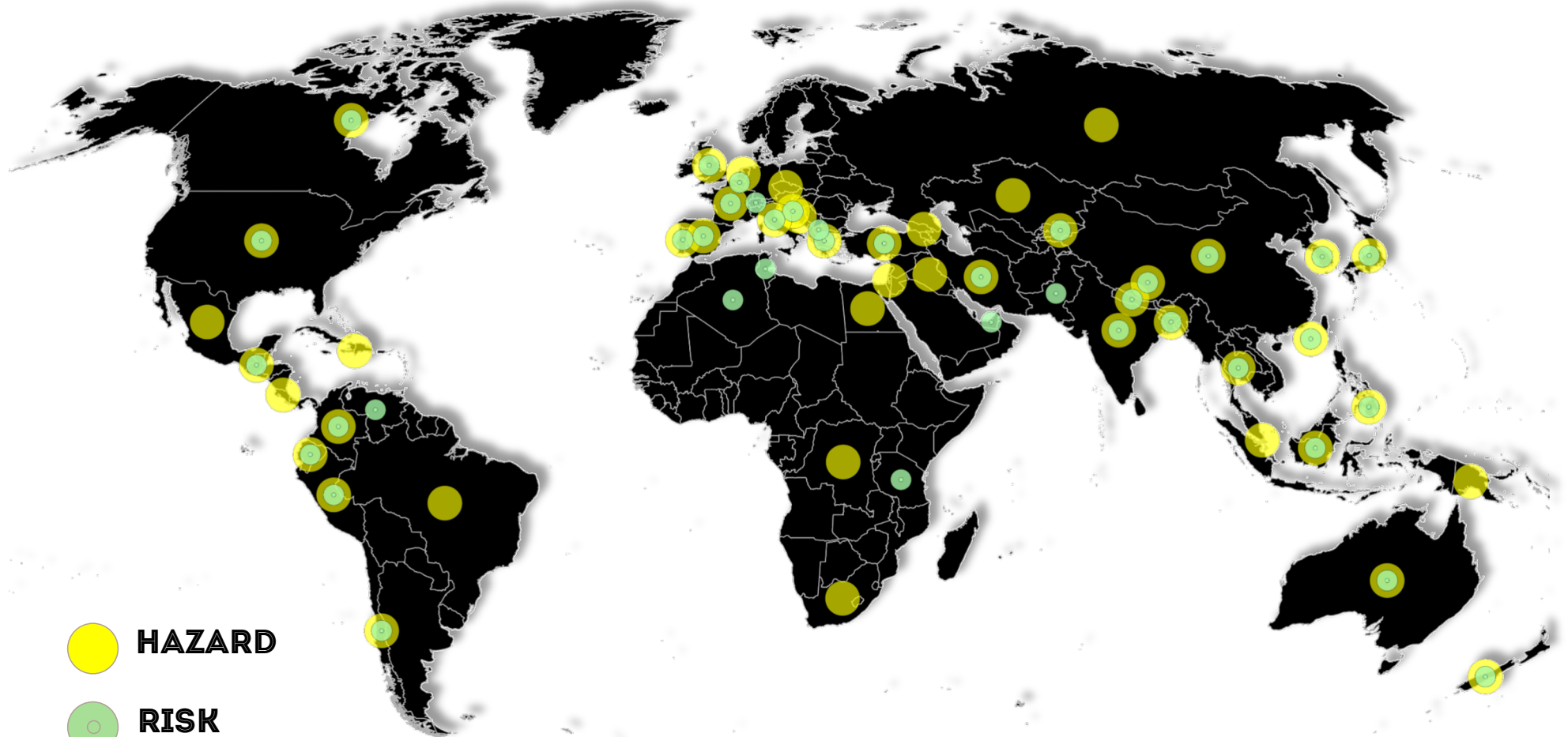
2017

2018

2019

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OPENQUAKE IS NOW MATURE AND USED GLOBALLY



Online training: https://www.youtube.com/channel/UCfvGcHtZYk_kQ_mqz3AYQYQ





THANK YOU