Optimal site hazard grid for probabilistic risk assessment: ***A two-step approach***

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GEM GLOBAL EARTHQUAKE MODEL working together to assess risk

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01 Background

Seismic risk analysis can be defined as the convolution of seismic hazard, exposure and vulnerability.

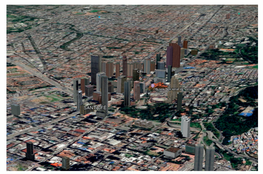
From a seismic hazard analysis, Ground Motion Fields [GMF] are calculated, representing a set of shaking intensities (PGA, SA, PGA, etc.) from a single or multiple events on a collection of hazard sites. Then, the GMF are used to estimate the expected damage or loss on every exposed asset given its vulnerability/fragility function.

In a Probabilistic seismic risk analysis [PSRA], very often a stochastic event set including the simulation of thousands of years of seismicity in order to estimate different risk metrics such as the annual average losses, the Maximum probable loss at a target return period, the annual rate of collapses, etc.

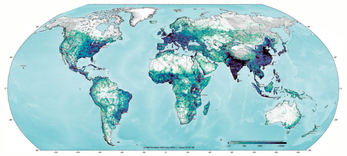
The calculation and storage of GMF is strongly related to the computational demand required for a PSRA. We propose a methodology to reduce the number of hazard sites with accurate seismic risk metrics results!

The *Increasing* size on database

High-detailed models

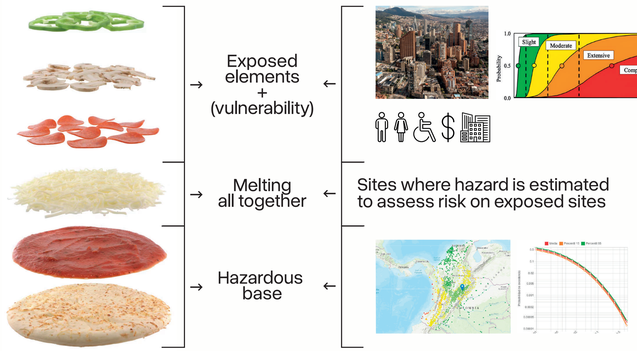


Lower scales at Broader areas



We can do an analogy with pizza, we have toppings exposed on top, and they are connected to the dough using the melted fior di latte cheese. Since a good cheese is expensive, a new way to optimize it without affecting the taste (representing the risk metrics) is welcome!

The *Pizza* parallel of PSRA

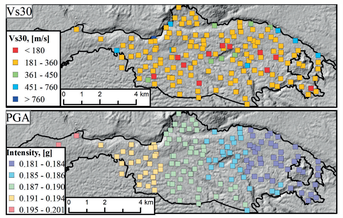


Is it possible to optimize the ***amount of cheese*** to have the same taste at the end?

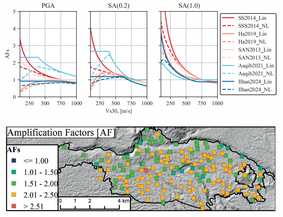
02 Methodology

Step-1: Creation Of Homogeneous Amplification Zones (Haz)

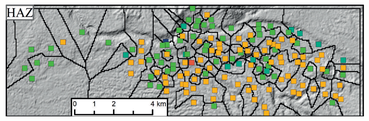
1. Hazard-related Inputs



2. Estimation of expected amplification

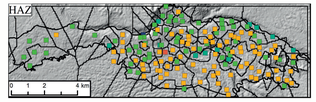


3. Clustering of HAZ



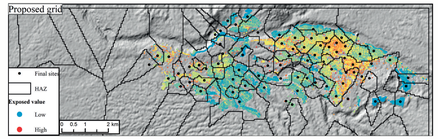
Step-2: Proposing Of Grid!

Input HAZ



Risk-related inputs (exposure)

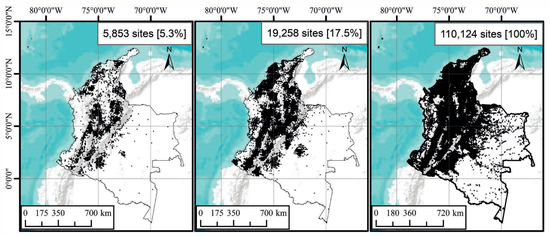
Weighted clustering of Final grid

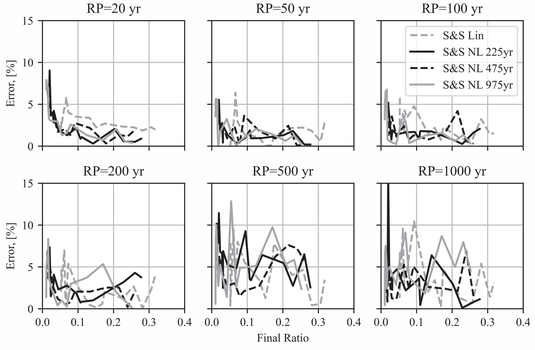


Additional rules:

- Max number of sites by HAZpol = Initial sites within HAZpol
- Solution of topological issues in complex HAZpol
- The target number of clusters by HAZpol depends on its exposure and a target number of sites.
- An additional binary search algorithm was implemented to find a grid with a specific number of sites.

03 Results





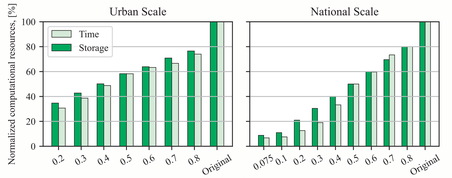
04 Conclusions

We proposed, implemented and tested a 2-step methodology to propose smart grids to optimize seismic risk analysis.

The 2 steps let to take advantage of both hazard (using site effects as proxy), and risk-related inputs (exposure) to reduce the number of sites where GMFields are estimated.

The methodology was tested at urban and national scale, including diverse site amplification models, and different input types.

The methodology was allocated in a github repository, and it is read to be used and tested!



05 References

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