GEM OpenQuake risk modeling framework
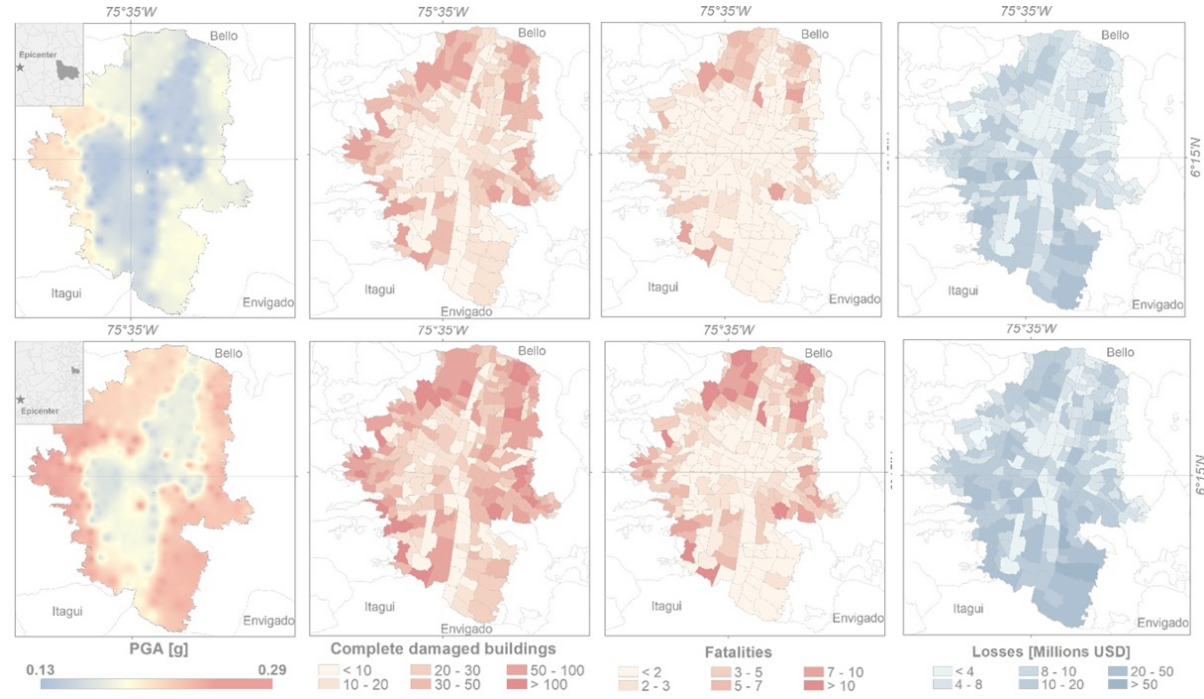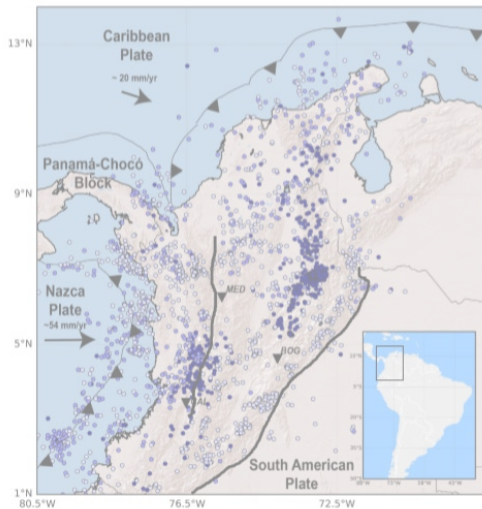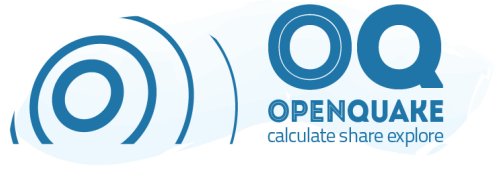

Ana Beatriz Acevedo · December 3rd 2020

Seismic risk assessment for the residential buildings of the major three cities in Colombia: Bogotá, Medellín, and Cali

Ana Beatriz Acevedo[1], Catalina Yepes-Estrada M.EERI[2], Daniela González[1], Vitor Silva M.EERI[2], Miguel Mora[3], Mónica Arcila[3], and Gustavo Posada[4]

Abstract

This study presents a seismic risk assessment and a set of earthquake scenarios for the residential building stock of the three largest metropolitan centers of Colombia: Bogotá, Medellín and Cali (with 8.0, 2.5, and 2.4 million inhabitants, respectively). A uniform methodology was followed for the development of the seismic hazard, vulnerability, and exposure models, thus allowing a direct comparison between the seismic risk of the different cities. Risk metrics such as exceedance probability curves and average annual losses were computed for each city. The earthquake scenarios were selected considering events whose direct economic impact is similar to the aggregated loss for a probability of exceedance of 10% in 50 years. Results show a higher mean aggregate loss ratio for Cali and similar mean aggregate loss ratios for Bogotá and Medellín. All of the models used in this study are openly accessible, enabling risk modelers, engineers, and stakeholders to explore them for disaster risk management.
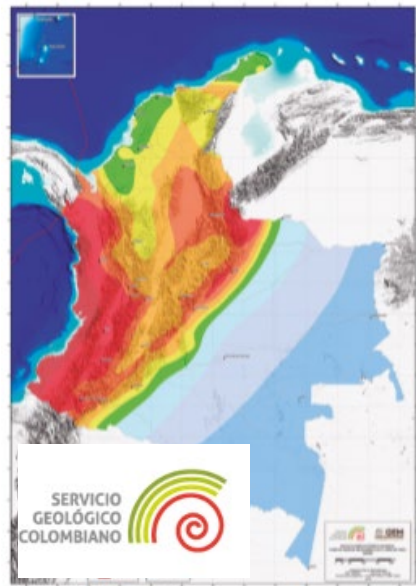
Keywords

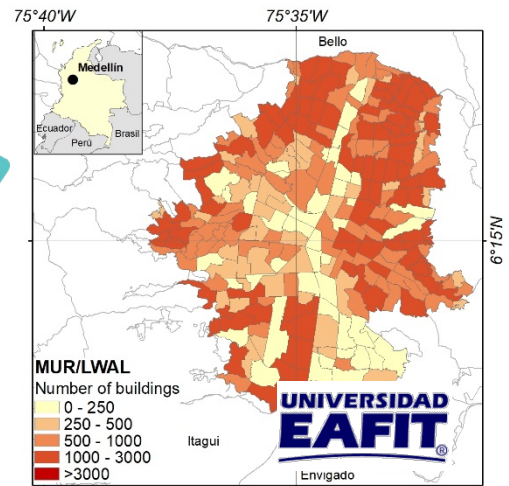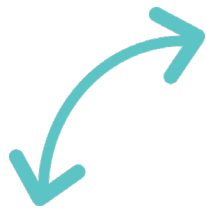Seismic hazard, residential buildings, seismic risk assessment, earthquake scenarios, risk metrics
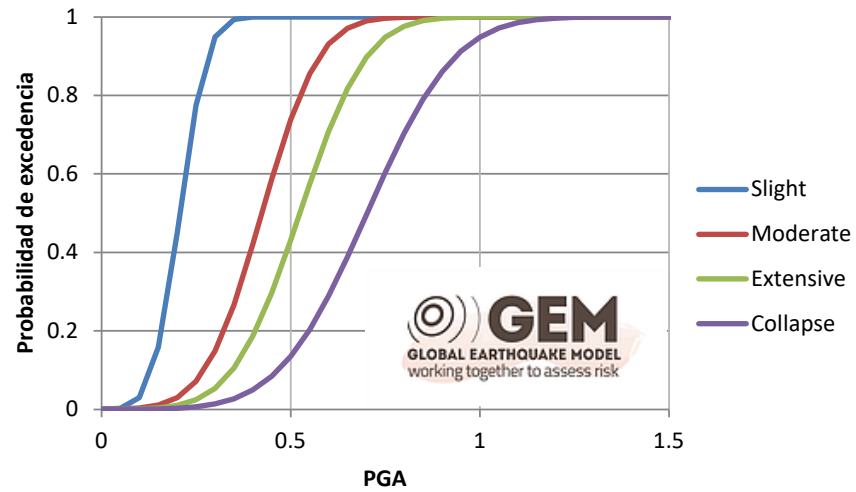
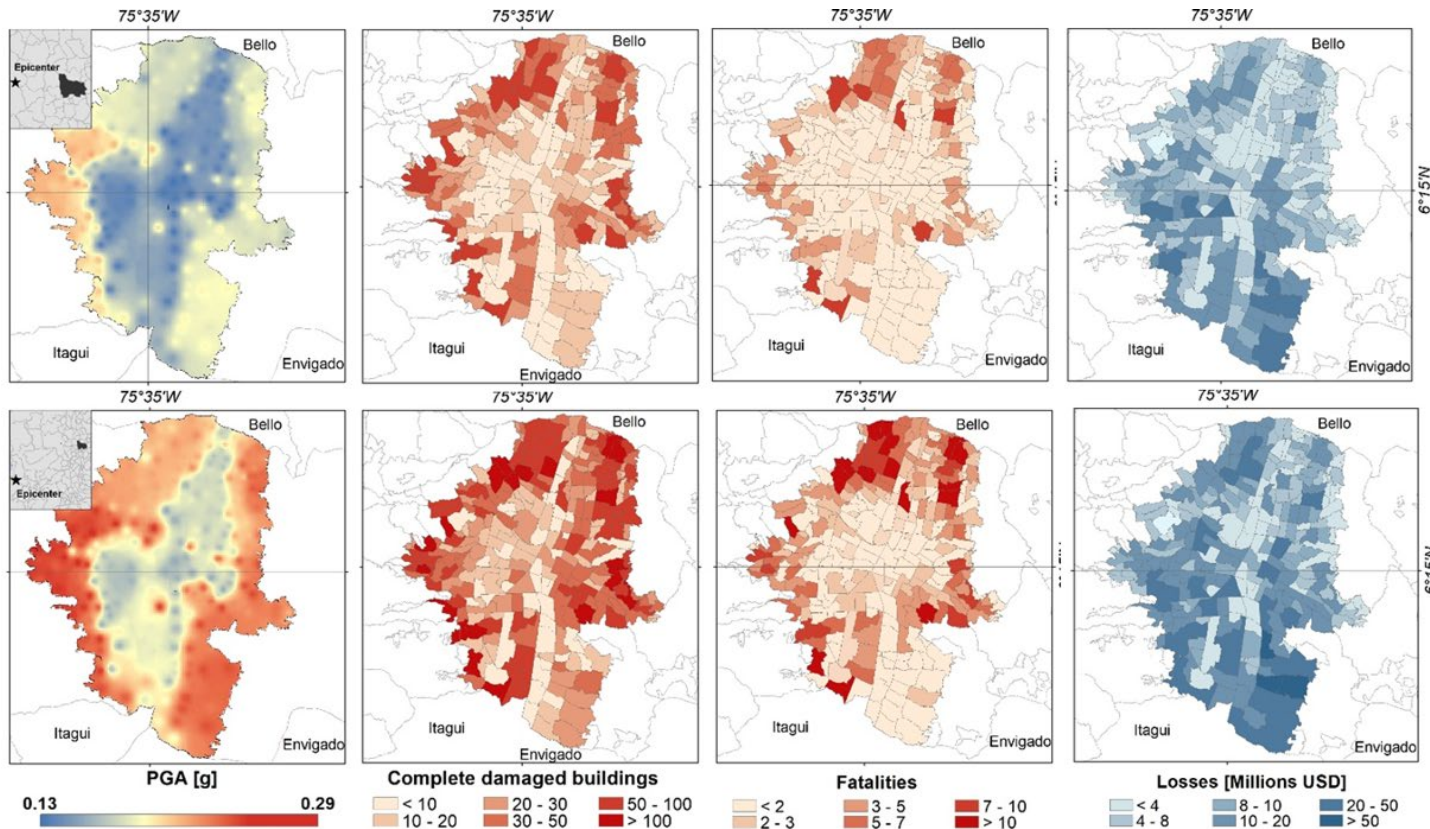# SEISMIC RISK ASSESSMENT

Exposure model

Seismic hazard model

Vulnerability model

EARTHQUAKE SCENARIOS

Consequences in terms of
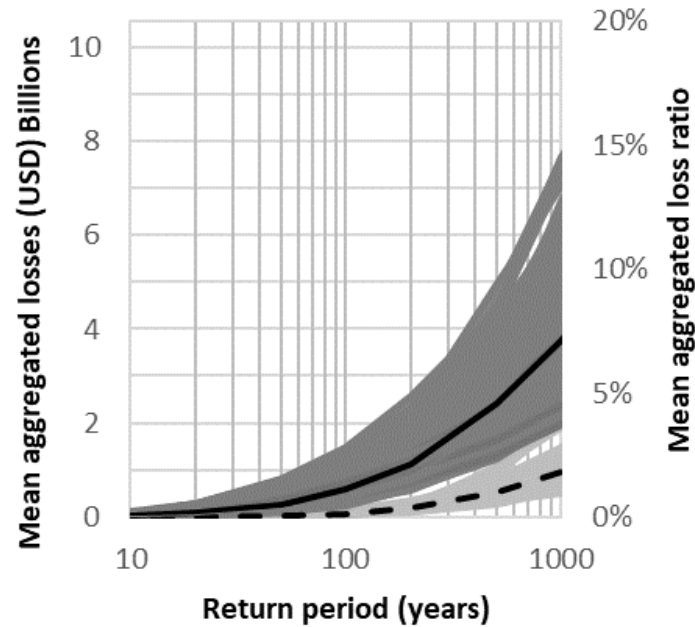
- Buildings in each damage stage:
  - No damage
  - Slight damage
  - Severe damage
  - Extensive damage
  - Complete damage

- Economic losses

- Effects on people
  - Number of injured
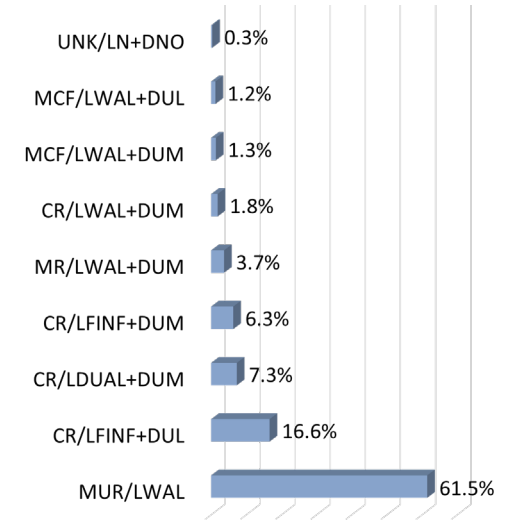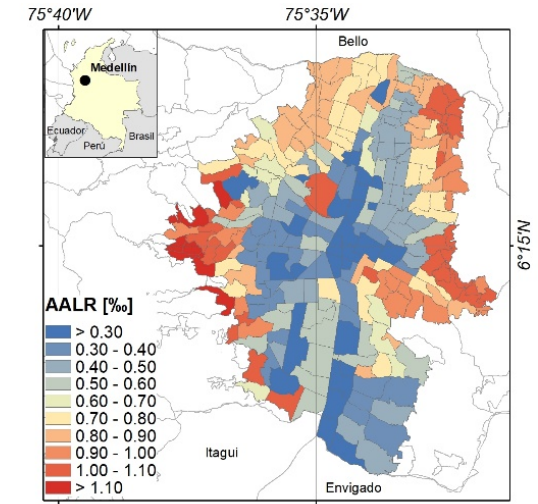 - Number of fatalities

RISK METRICS

Loss exceedance curves for rock and soil conditions. Black lines: mean values for rock (dashed lines) and soil (continuous lines). Gray lines: logic tree-branch for rock (lighter lines) and soil (darker lines)

Average annual loss (AAL) = USD 30 million

Average annual loss ratio (ALLR) = 0.58 ‰

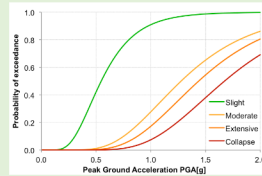Distribution of average annual loss ratio, AALR and contribution of building classes to the AALR
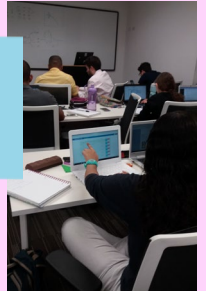
Timeline (2013–2020)

- 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020

- South America Risk Assessment (SARA) project 2013-2015
- OQ introduction
- OQ training
- Earthquake scenarios for unreinforced masonry buildings
- Training on seismic risk
- OpenQuake in the classroom
- Capacity building in Colombia
- Master and doctoral thesis with OpenQuake
- Collaborative work
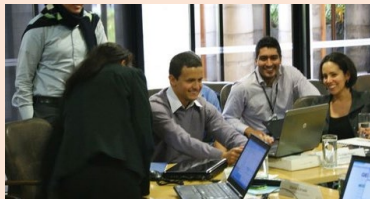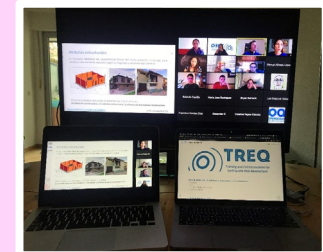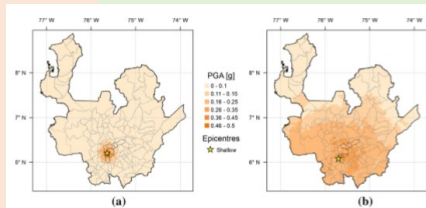
Key issues on urban earthquake risk assessment

- ¿How can we develop more accurate models?
- ¿How should we consider the uncertainty in the risk assessment?
- ¿How to chose earthquake scenarios?
- ¿How should we consider soil effects?
- ¿How to consider earthquake secondary effects?
- We need to develop vulnerability models for local building typologies
- …

We need to understand social-economic effects derived from earthquakes
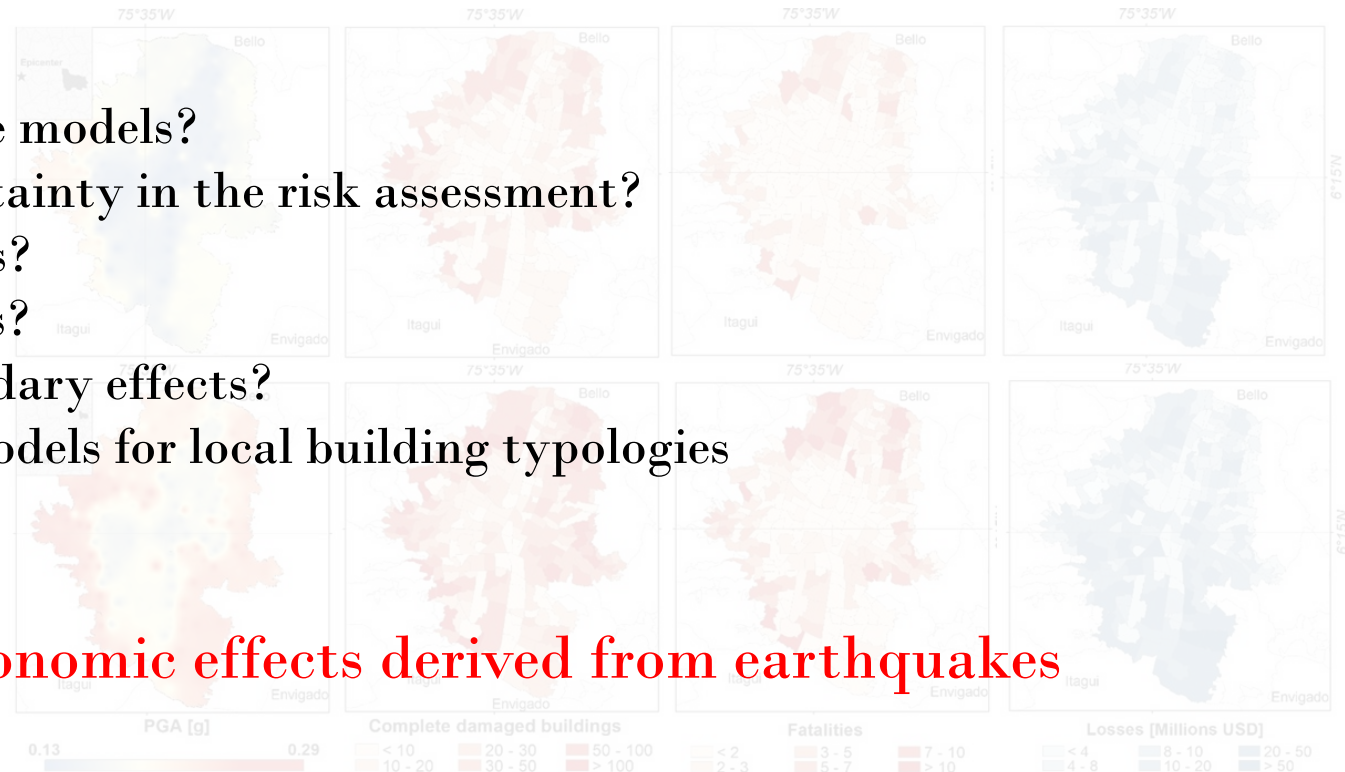
Key issues on urban earthquake risk assessment

- Multidisciplinary work
- Collaboration
- Open source technology
- Building capacity
- Risk education and communication
- People-centric metrics

Thanks