Promoting earthquake awareness in Africa through the GEM global hazard mosaic

Valerio Poggi, Julio Garcia, Marco Pagani, Robin Gee., Richard Styron, Kendra Johnson

Global Earthquake Model (GEM), Pavia Italy

December 7th, 2017, Madrid - Spain



working together to assess risk





Introduction to GEM

GEM (**Global Earthquake Model**) is a no-profit organization funded by public and private partners aimed to stimulate the awareness on seismic hazard and risk worldwide

The overall goal of the hazard component of the GEM community is:

- the construction of a global mosaic of open hazard models
- to provide the community with tools, datasets and knowledge to achieve this goal





GEM's Philosophy

All GEM products (models, software, databases, training material) are meant to be:



1) Collaborative

We promote interaction and collaboration between scientists, professionals and experts from national institutions and worldwide



2) Open and transparent

All input information, data and results are openly accessible to the community for verification, improvement or any other use



GEM's Philosophy

Why is it useful?

- Transparency and reproducibility can increase acceptability
- It can reduce erroneous criticism
- Testing becomes a more effective process (feedback process, identification of bugs...)

Only in this way it's possible to ensure long term maintenance, incorporate newest ideas and features and aim at a large community of users





Reproducibility in Seismic Hazard

What's a reproducible PSHA model?

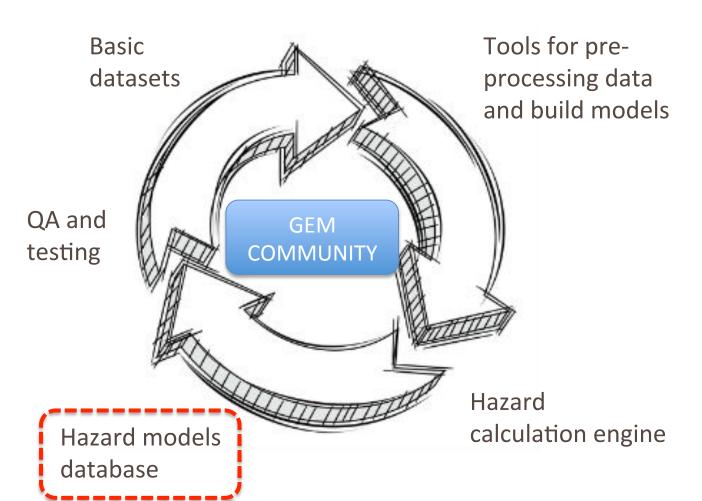
- The basic information used for its construction is openly accessible on public repositories
- The tools used for the construction of the hazard model are accessible on a public repository
- The model building process is documented in a way that an independent modeller will be able to reproduce the model

The calculation are performed with a freely accessible software

(possibly open-source)



GEM Hazard - Open Products



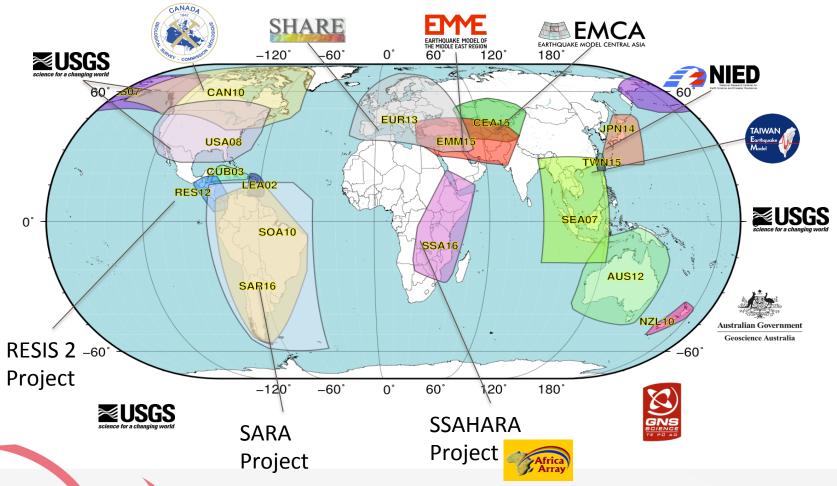






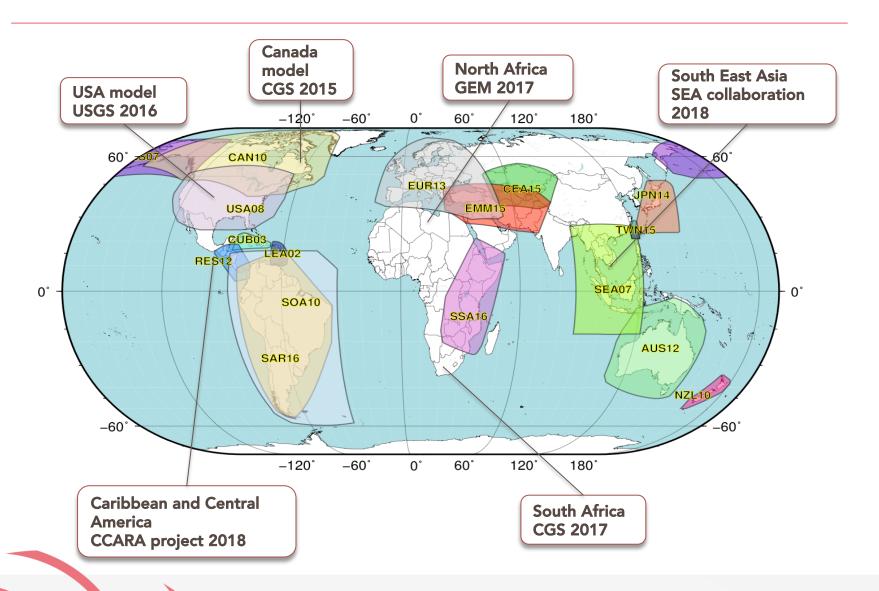
GEM Global Database of Hazard Models

The DB contains hazard models developed by national agencies and international projects which are openly distributed





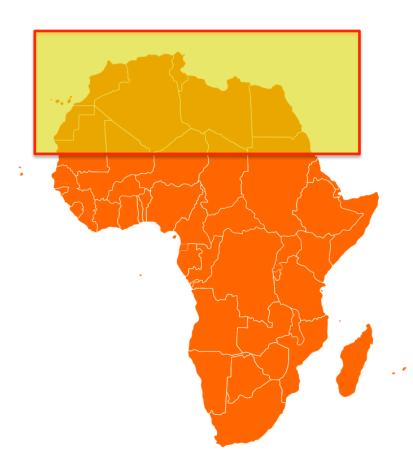
GEM Global Database of Hazard Models





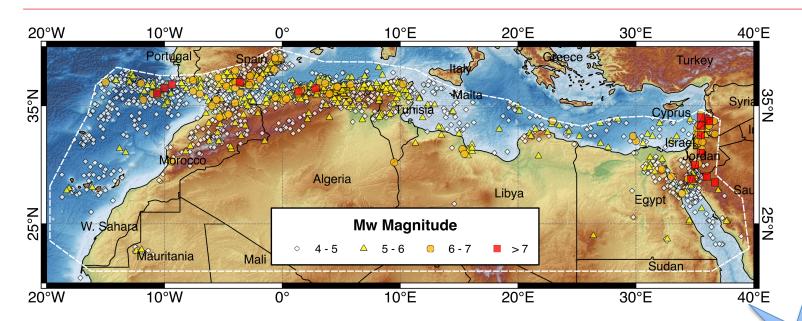
Earthquake Hazard in North Africa: a GEM product

- Besides the East African Rift System, significant seismicity also occurs along a wide belt bounding the Mediterranean coastline
- Several past large earthquakes caused a non-negligible level of damage
- A reliable risk assessment is therefore essential, which requires a state-of-art hazard assessment for the region
- 4 There is a need for a new probabilistic seismic hazard model based on the most recent and up to date available information



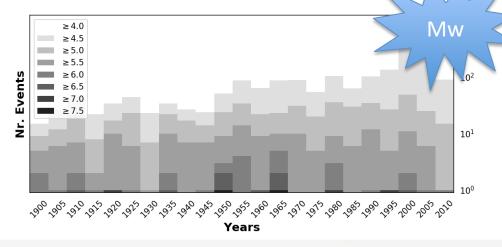


North Africa Homogenized Earthquake Catalogue



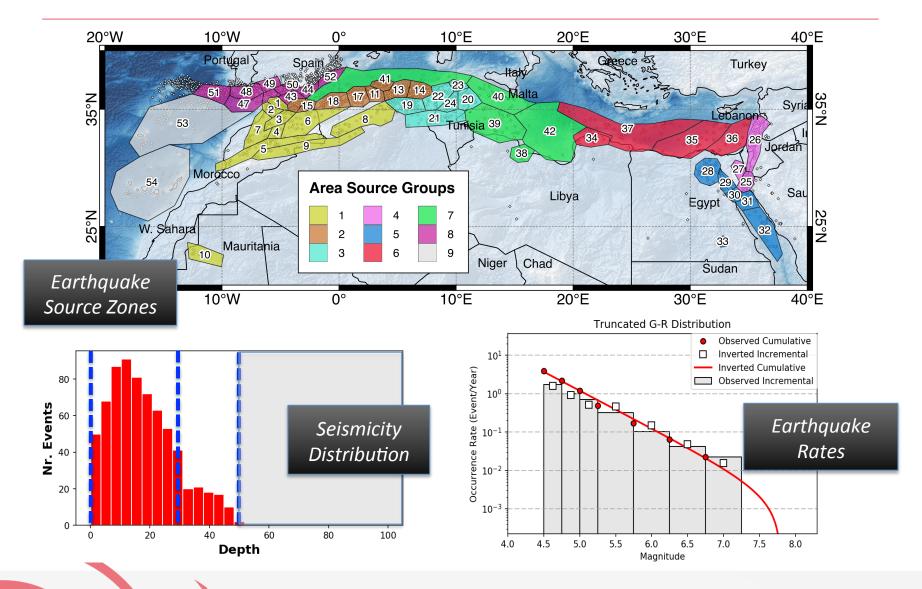
The catalogue is obtained by harmonization of global bulletins with data from local agencies and published studies

Number of Events: 5170 Year Rage: 1016 - 2013 Magnitude Rage: 4.0 - 8.5



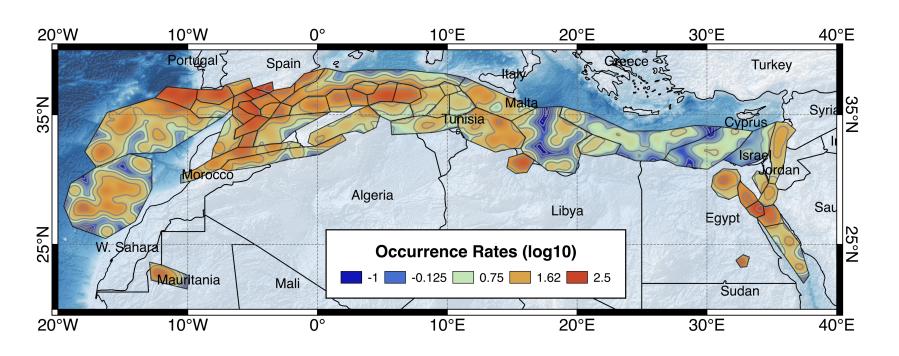


Source Model - Regional Seismicity Analysis





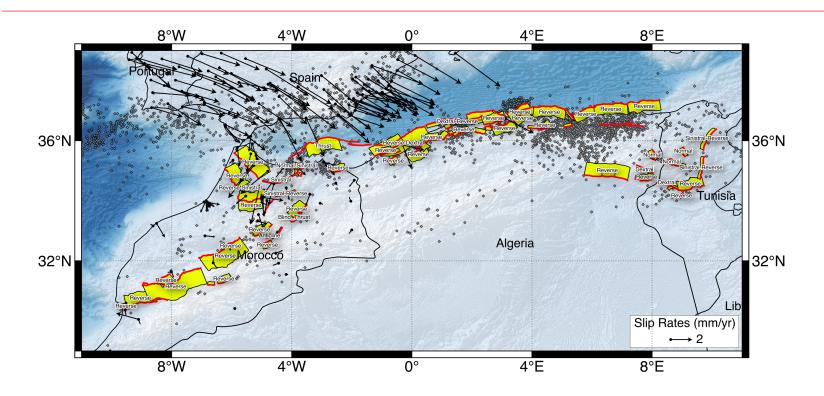
Occurrence Rate Redistribution



For the definition of the background seismicity model we have implemented a smoothing procedure based on area source zonation, where the observed rates are spatially redistributed according to the seismicity pattern of the area



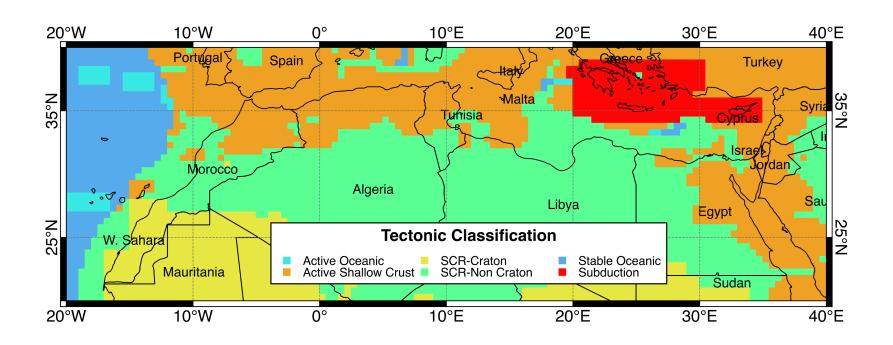
Global Active Fault Database



- New database of active faults from Morocco to Sinai
- 143 structures mapped from literature, satellite imagery, topography, seismicity
- Slip taken from literature or estimated from GPS
- Public and open-source (Creative Commons Attribution license)



Tectonic Regionalization using Fuzzy Logic



Chen et al. 2017 (Under review)

Merging information from:

- Seismicity (magnitude)
- Smoothed Moment rate
- S-wave velocity
- Q_{LG} distribution



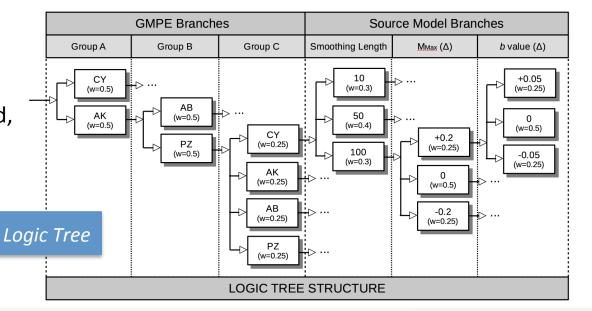
GMPE Selection and Logic-Tree Approach

Given the peculiar seismoteconic setting of the North Africa, an hybrid attenuation behavior might be expected. Four suitable GMPEs have been selected:

- 1 Chiou & Youngs (2014)
- 2 Akkar et al. (2014)
- 3 Atkinson & Boore (2006)
- (4) Pezeshk et al. (2011)

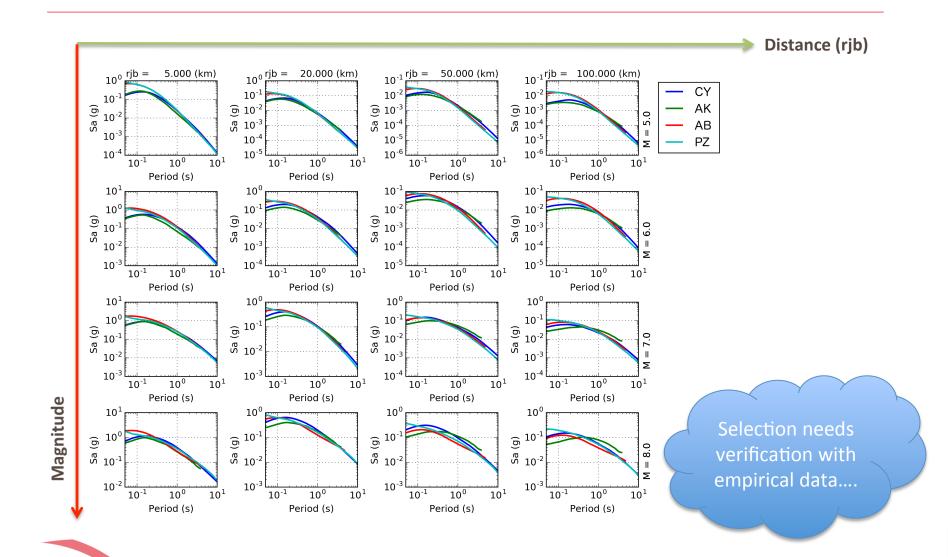
- → Active Shallow Crust
- → Stable Continental Crust

Three main tectonic groups are then identified, each with a different GMPE weighting scheme

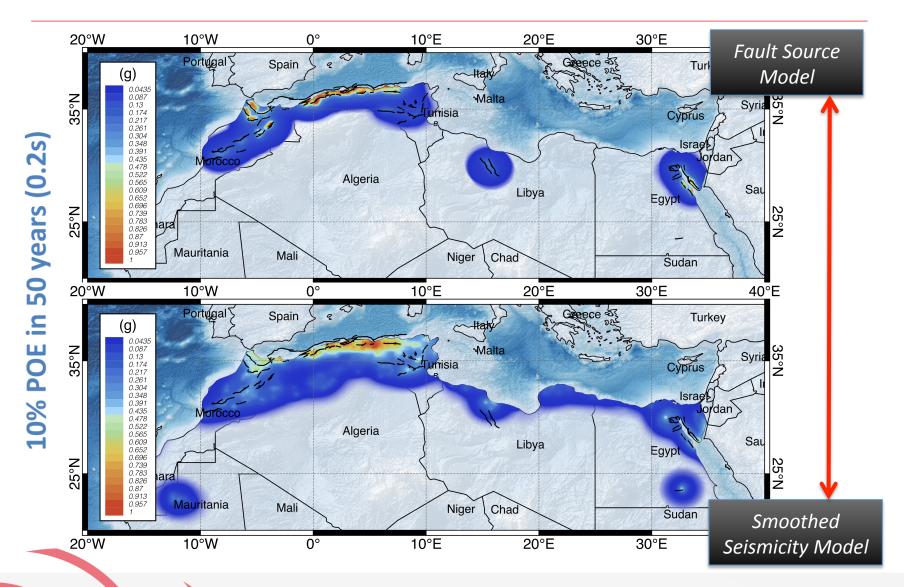




GMPE Selection – Comparing Ground Motion

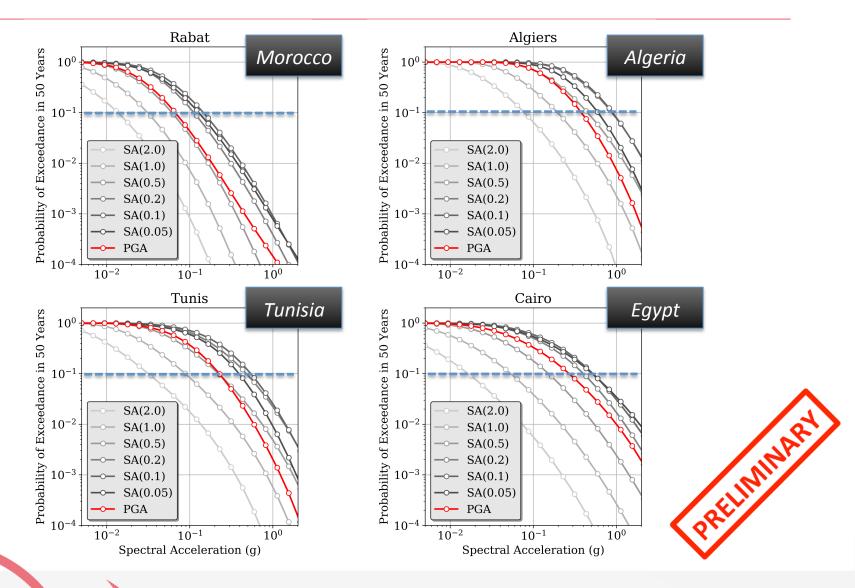


Preliminary Hazard Results



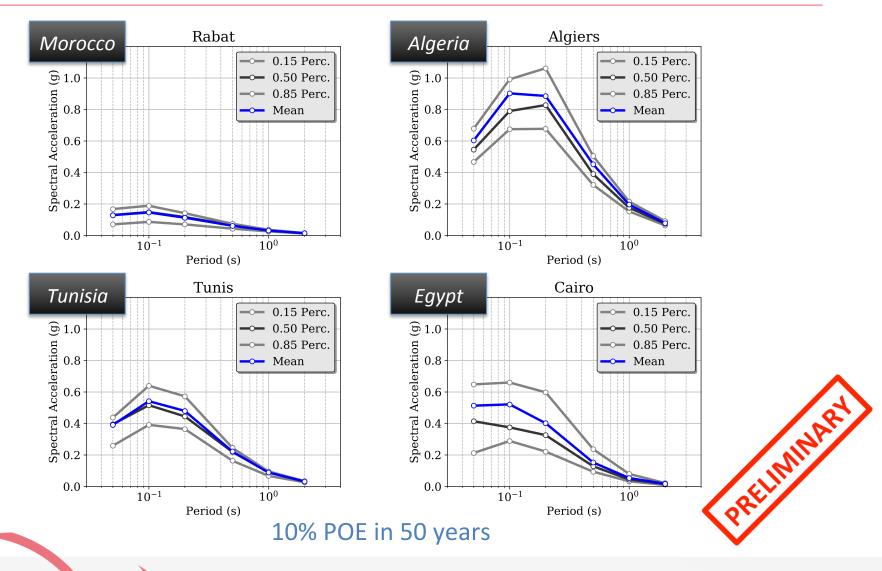


Hazard Curves @ African Capitals





Uniform Hazard Spectra @ African Capitals





Missing Components / Improvements

The North-Africa Hazard model is presently just in a GEM product, but it is meant to be improved and expanded with the collaboration of the African and worldwide scientific community

While existing components can be improved, many other components are still missing, such as:

Integration of local hazard studies

Strong motion recordings from local networks

Site-specific studies and microzonation





Thank you!

Except where otherwise noted, this work is licensed under https://creativecommons.org/licenses/by-nc-nd/3.0/
Please attribute to the GEM Foundation with a link to www.globalquakemodel.org



