A Probabilistic Seismic Hazard Model for Sub-Saharan Africa

Valerio Poggi[1], Graeme Weatherill[1], Julio Garcia[1], Marco Pagani[1]
R. Durrheim[2], G. Mavonga Tuluka[3], A. Nyblade[4]

1 - Global Earthquake Model (GEM), Pavia Italy
2 - University of the Witwatersrand, Johannesburg, South Africa
3 - Goma Volcanic Observatory, DR Congo
4 - Penn State University, USA

June 30, 2016, Addis Ababa - Ethiopia

working together
to assess risk

GEM
GLOBAL EARTHQUAKE MODEL

OQ
OPENQUAKE

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 African 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?

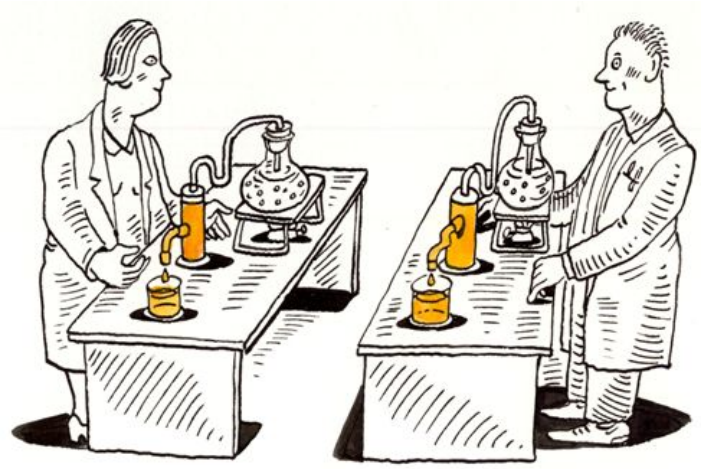
- Transparency and reproducibility can increase acceptability
- It can reduce erroneous criticism
- Testing becomes a more effective process (feedback process, identification of bugs…)

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

Basic datasets

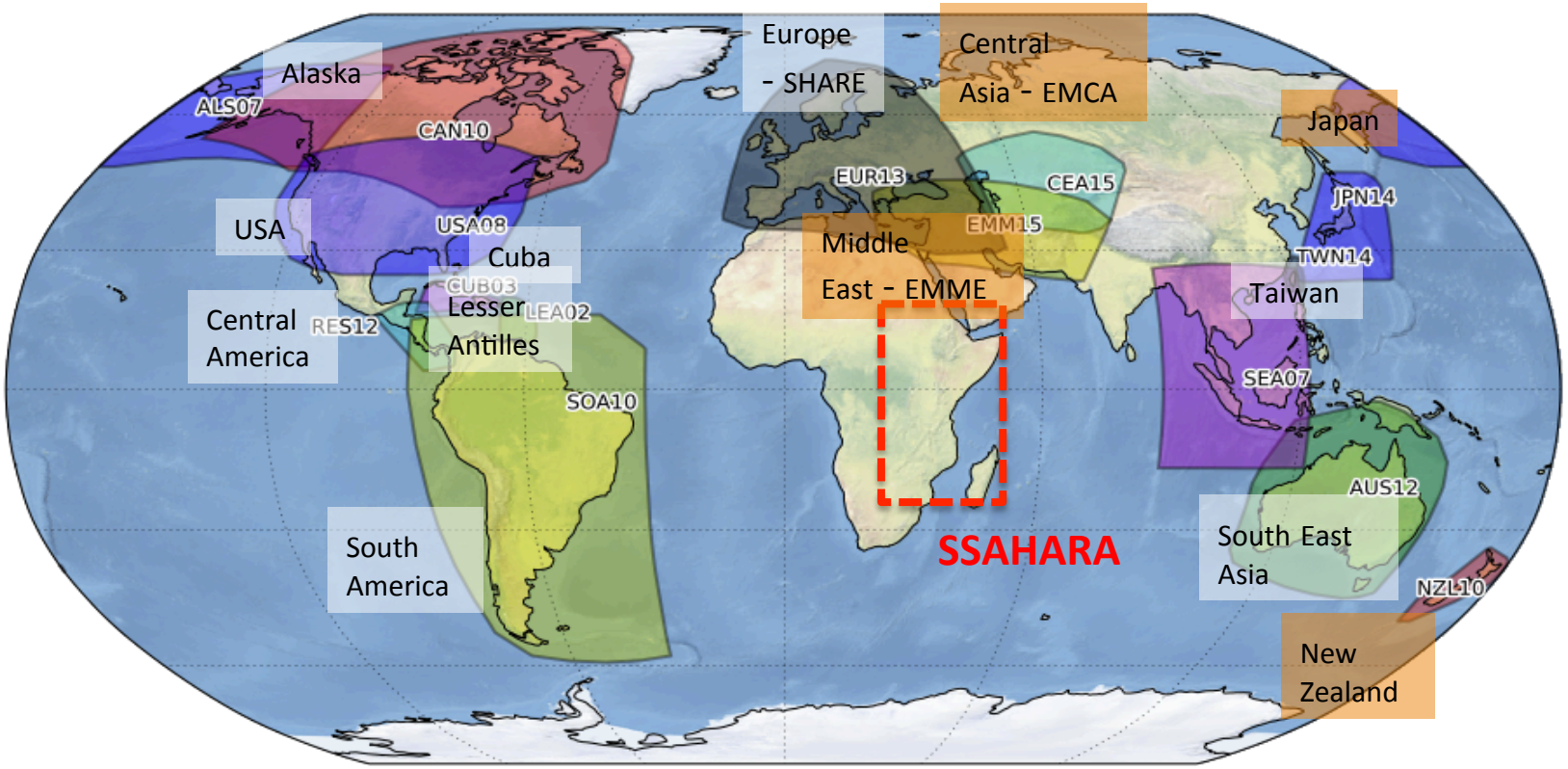
Tools for pre-processing data and build models

QA and testing

Hazard models database

Hazard calculation engine

GEM Global Database of Hazard Models



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

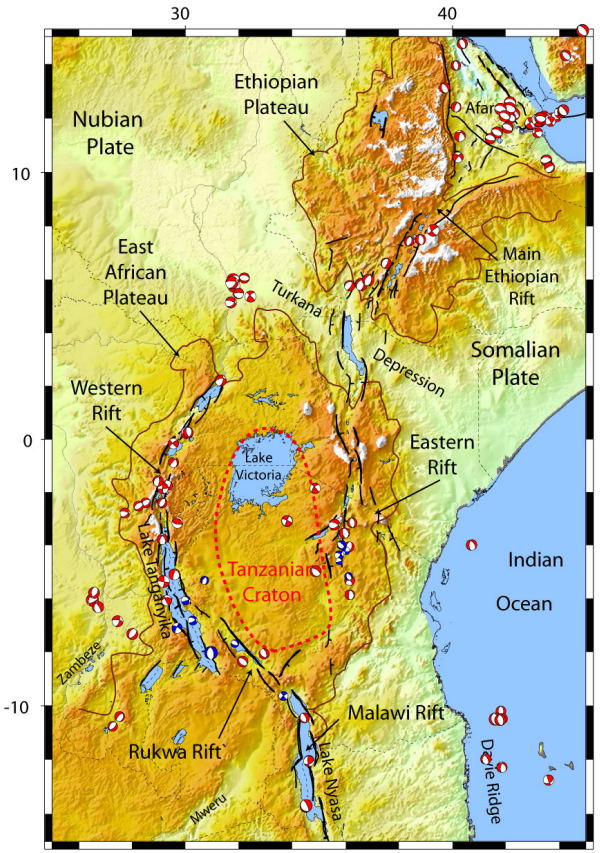
Earthquake Hazard in Sub-Saharan Africa

① The **East African Rift System** (EARS) is the major active tectonic feature of the **Sub-Saharan Africa** (SSA) region

② Several past large earthquakes caused a non-negligible level of damage

③ 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



The Sub-Saharan Africa Hazard Model

Sub-Saharan Africa (SSA) Hazard Model is a pilot project led by GEM and **AfricaArray** and supported by **U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT** (USAID)

Original goals:

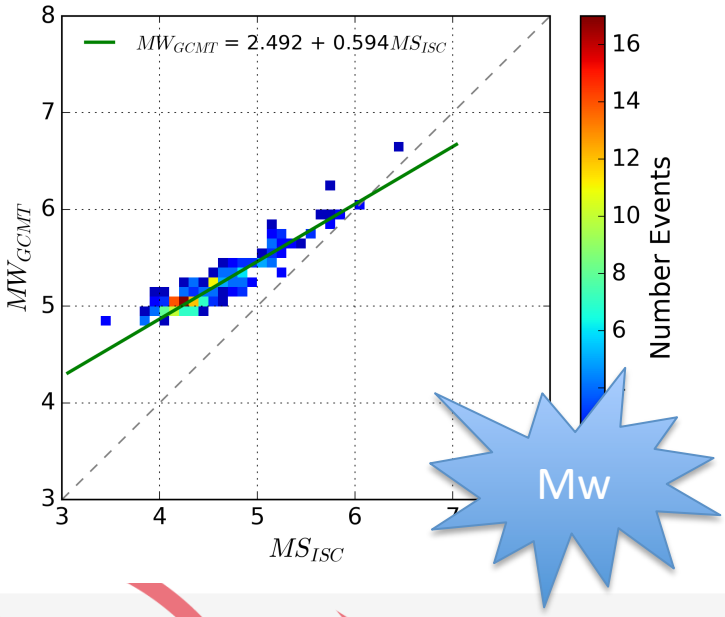
- Development of an explorative hazard model for SSA region
- Assess the usefulness of AfricaArray data for hazard mitigation

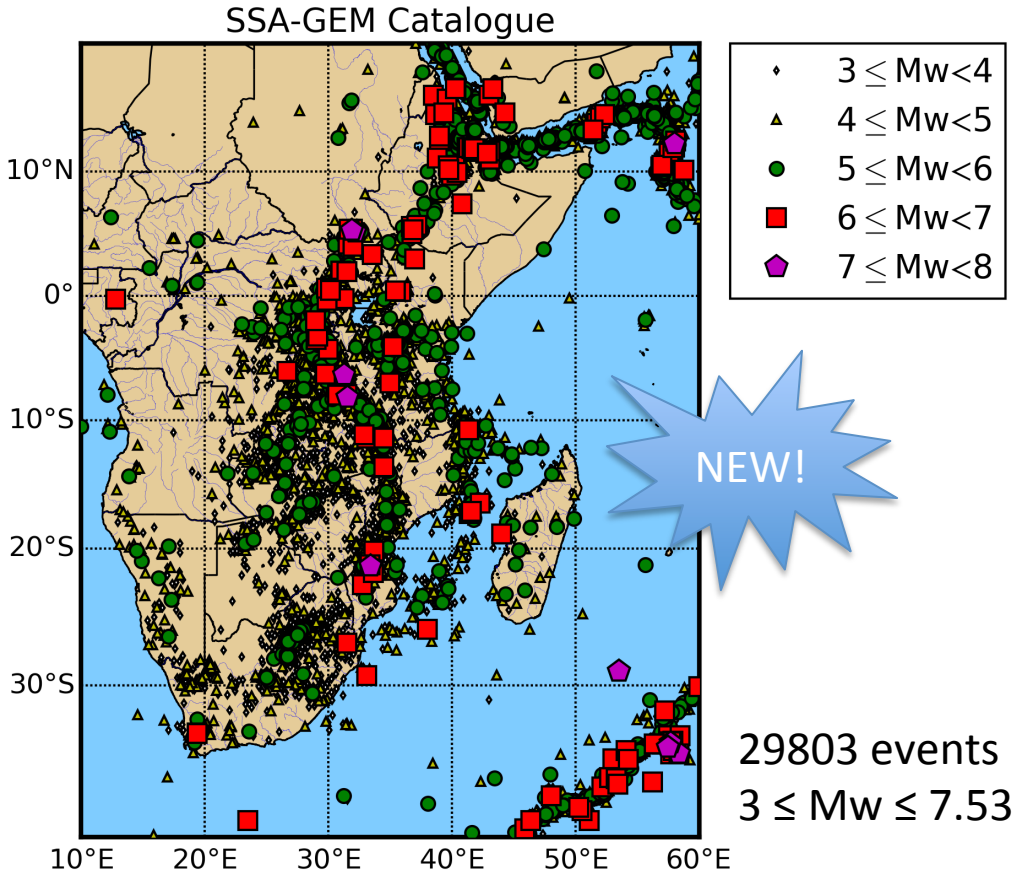
Available components / achievements:

- Improved earthquake catalogue
- Source zonation model and regional seismicity analysis
- Strain rate model
- Final hazard model

SSA Hazard Model – Improved Earthquake Catalogue

SSA Catalogue is obtained by harmonization of global bulletins with data from local agencies and regional projects, particularly from the **AfricaArray** framework

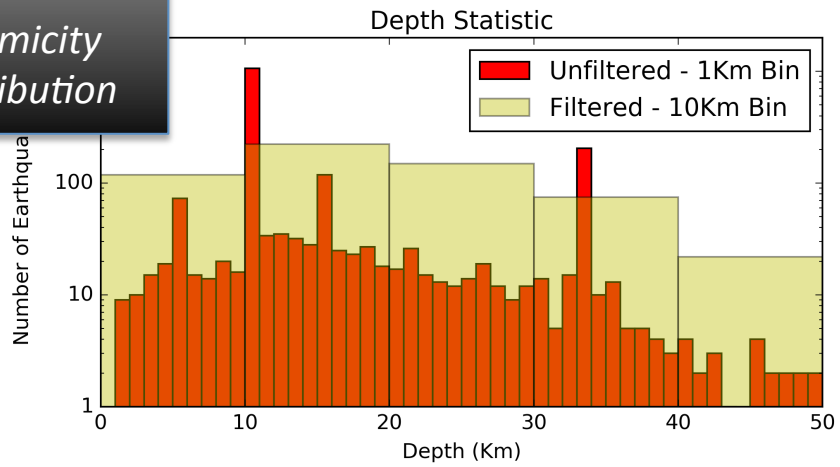


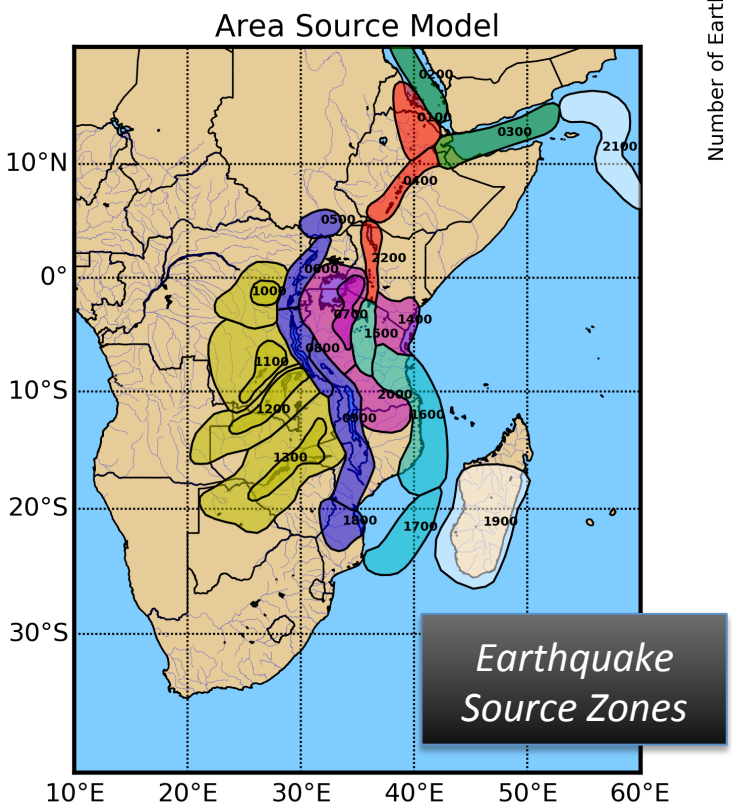


29803 events
3 ≤ Mw ≤ 7.53

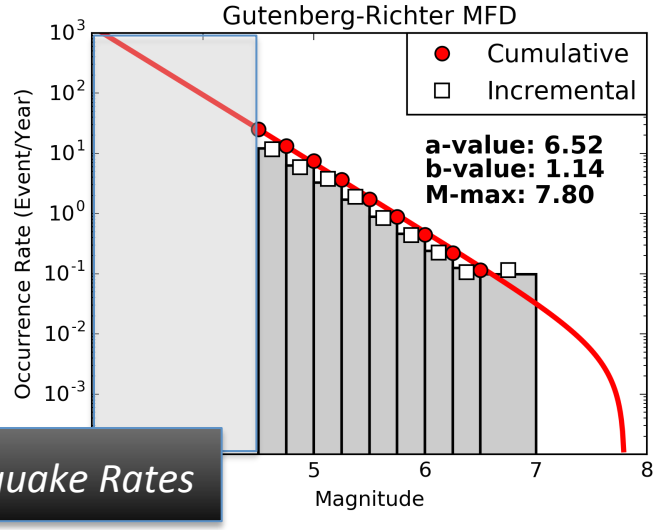
SSA Hazard Model – Regional Seismicity Analysis

Seismicity Distribution



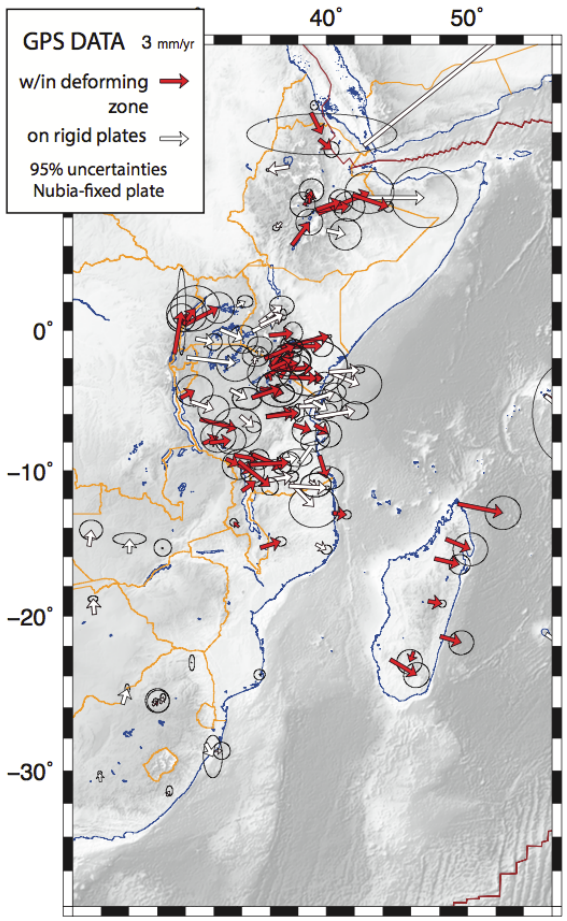


Earthquake Source Zones



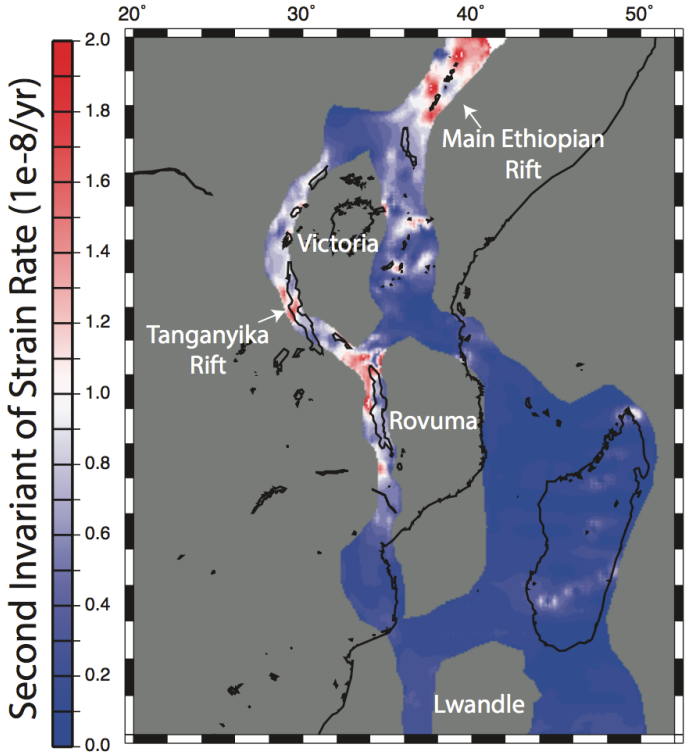
Earthquake Rates

SSA Hazard Model – Strain Rate Model

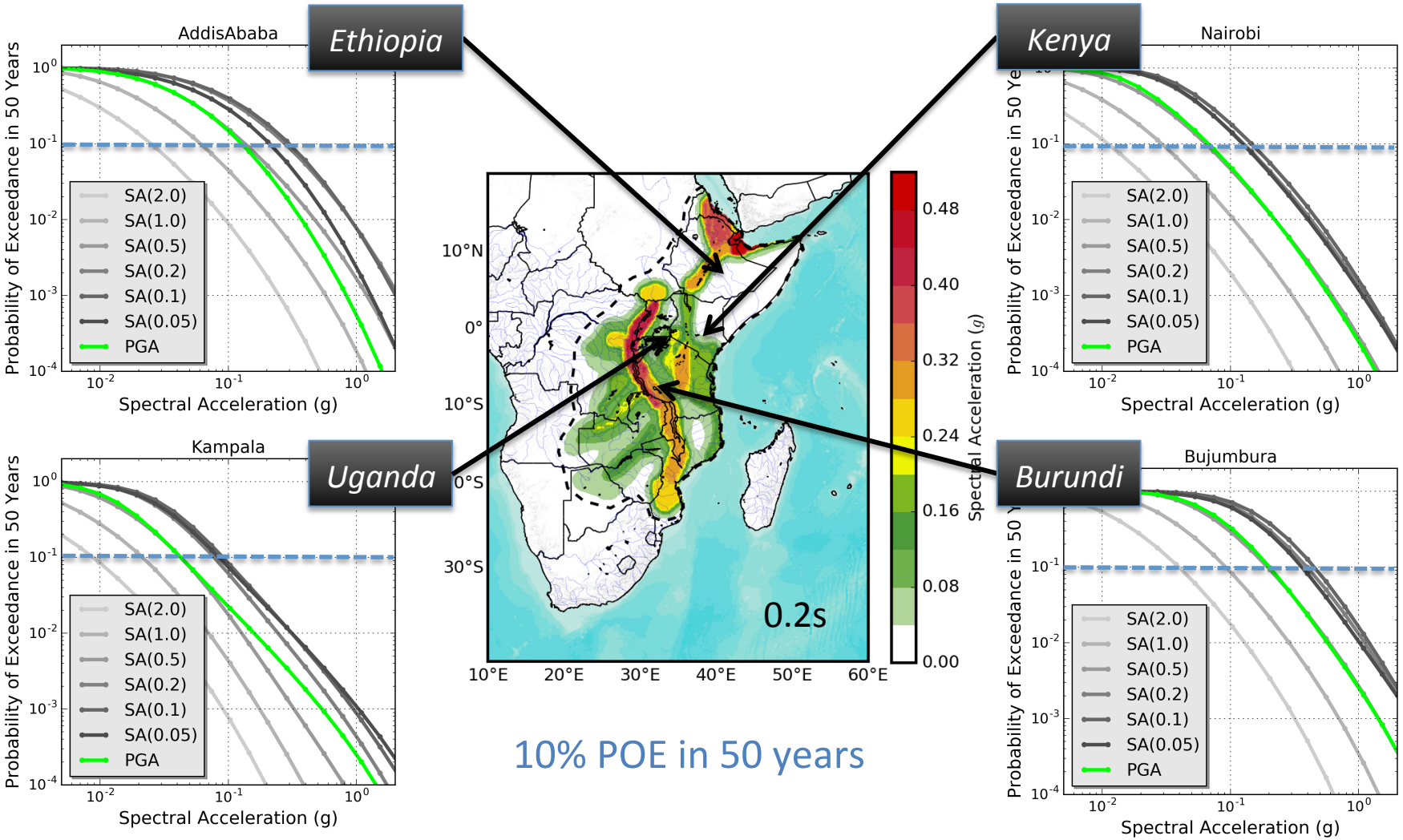


Stamp et al. 2015

A geodetic strain-rate model from observed GPS displacement have been elaborated with a collaboration between African and US scientists



Hazard Curves @ African Capitals



10% POE in 50 years

Missing Components

The SSA Hazard model is presently just in a pilot version, that will be eventually improved and expanded within future collaborations with African scientific community

Many components are still missing, such as:

- Active faults information and paleoseismicity
- Integration of local hazard studies
- Strong motion recordings from local networks
- Site-specific studies and microzonation

Need for a collaborative effort

Moving Forward

Outlook:

- Review/integration of the open SSA model by African community
- Integration of the model with new national models currently under development
- Creation of a core group of experts on African hazard
- Extend model to a continental scale
- Extend model to a national scale and integrate with local building codes

What GEM is presently offering to make that happen:

- High-level scientific expertise
- Tested and openly available tools for earthquake hazard mitigation
- Community-based development and networking
- Support for initiatives at local and national scale
- Training and capacity development

Thank you!