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GLOBAL EARTHQUAKE MODEL

working together to assess risk

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Update of the Global Hazard Model

The GEM Global Hazard Mosaic Update 2023

GEM Seismic Hazard and IT Teams

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GEM Release of Hazard and Risk Products
October 13th, 2023

OPENQUAKE

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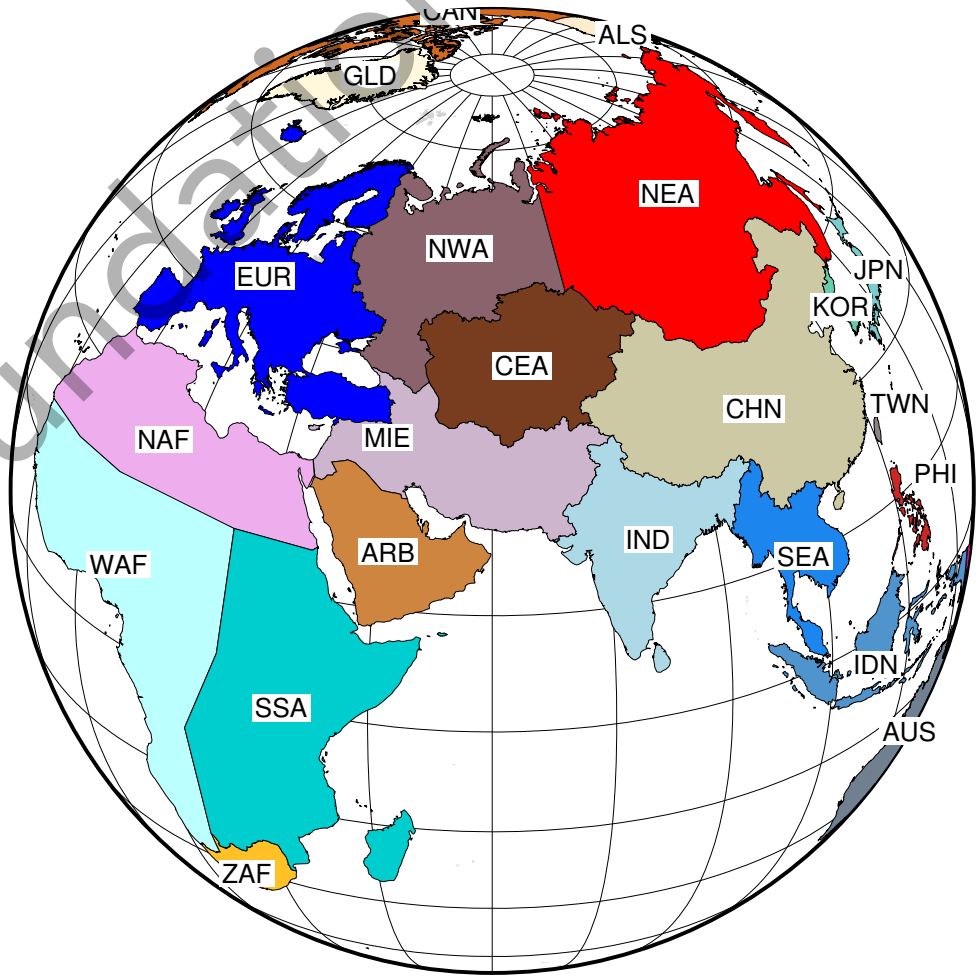
The GEM Global Mosaic

- The GEM Global Mosaic is a collection of seismic hazard models that overall provide hazard values for most inland areas globally
- The first version was released at the end of 2018 and since then it has been updated and improved regularly by GEM
- The mosaic is a basic dataset for computing a variety of products such as the global hazard and risk maps



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The Mosaic (version 2023)

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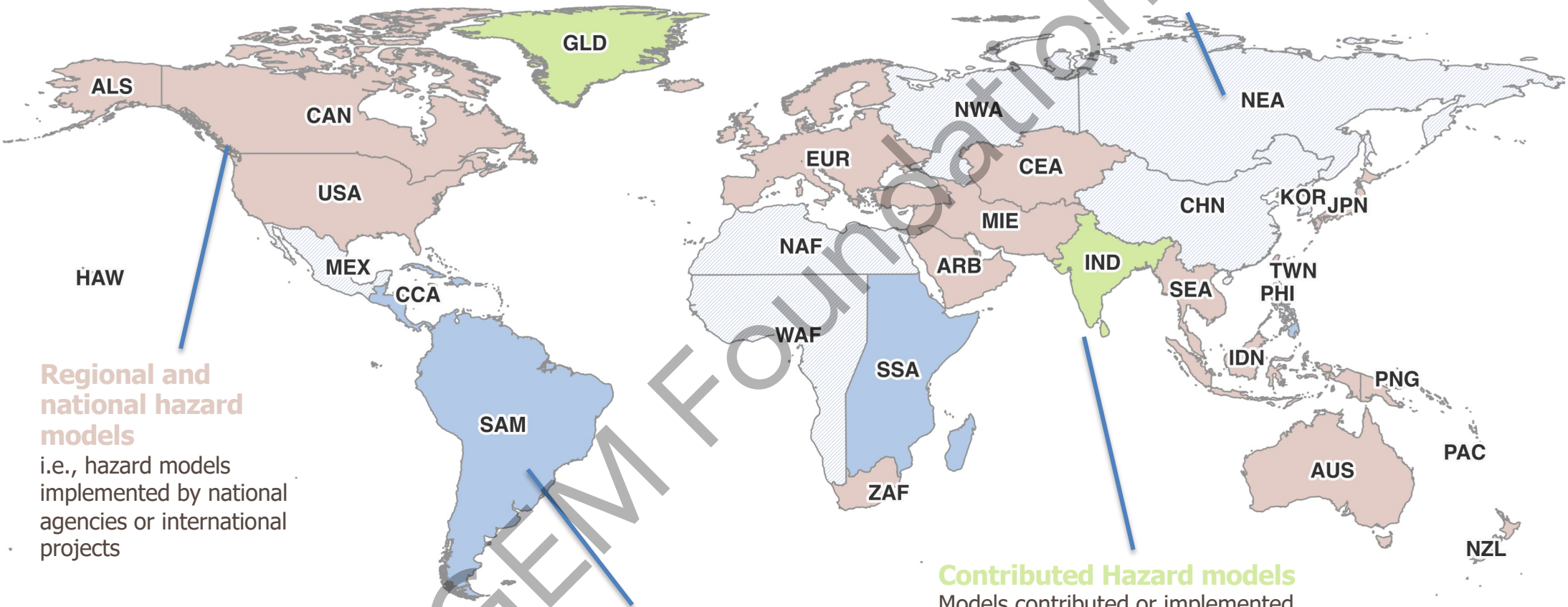

GEM Internal Hazard models
Models implemented by the GEM Hazard Team

Regional and national hazard models
i.e., hazard models implemented by national agencies or international projects

Hazard models with development coordinated by GEM
Models implemented by the GEM Hazard Team within regional projects

Contributed Hazard models
Models contributed or implemented using information included in scientific papers

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Improvements/changes in the current release

Models | **Hazard Calculation** | **Results**

- Improvements to earthquake occurrence and ground-motion modelling
- New models

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The Main Components of the Mosaic

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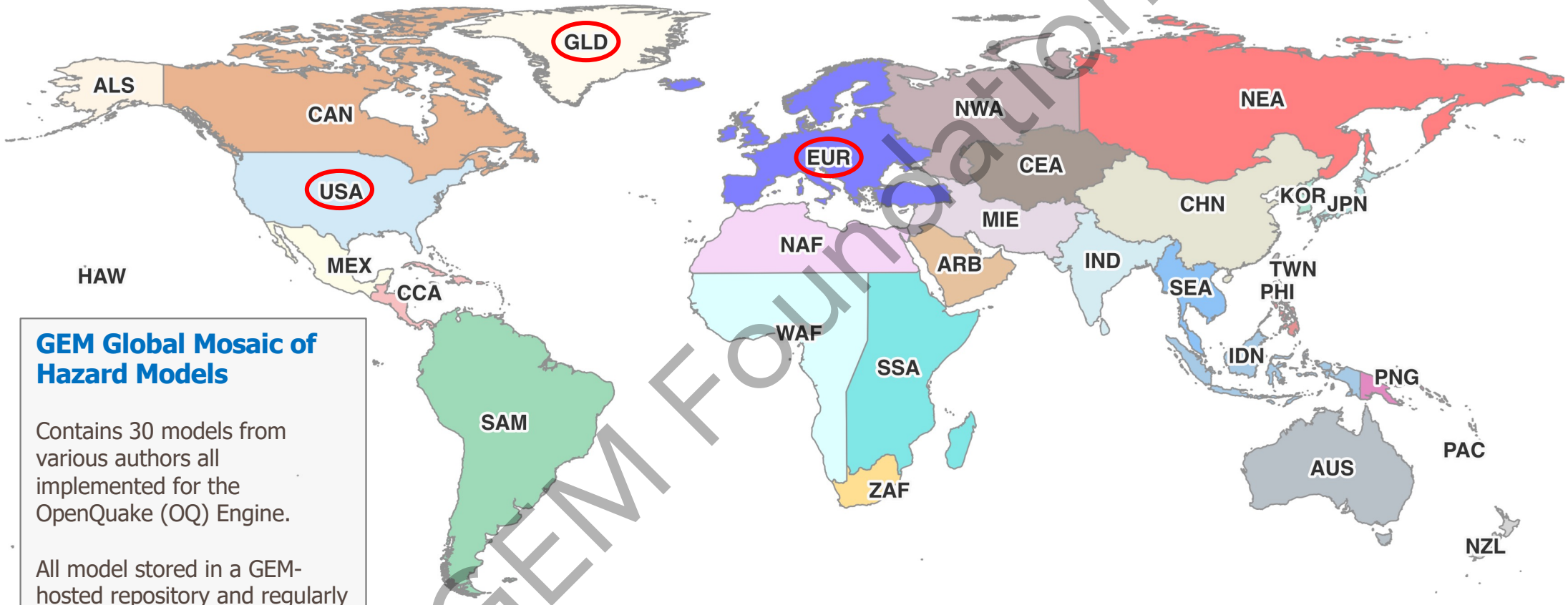

GEM Global Mosaic of Hazard Models

Contains 30 models from various authors all implemented for the OpenQuake (OQ) Engine.

All model stored in a GEM-hosted repository and regularly tested against OQ.

Various models openly available on the GEM website.

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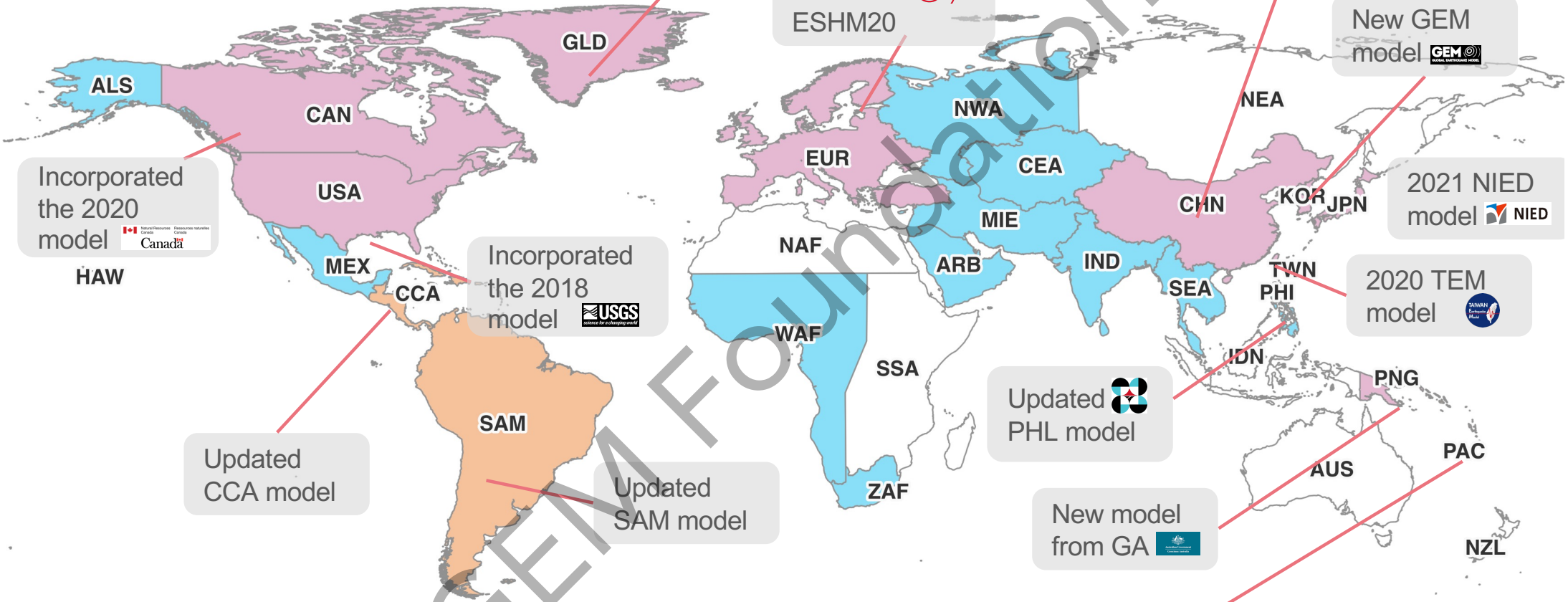
Models' upgrade



Not included in 2018

Added ESHM20

New GEM model

New GEM model

Incorporated the 2020 model

2021 NIED model

Incorporated the 2018 model

2020 TEM model

Updated PHL model

Updated CCA model

Updated SAM model

New model from GA

Updated PAC model

New models

Models with updated ground motion models with respect to 2018

Models with updated SSC and GMC with respect to 2018

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Improvements/changes in the current release

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Models

- Improvements to earthquake occurrence and ground-motion modelling
- New models

Hazard Calculation

- Horizontal component of motion
- Truncation of GM aleatory distribution
- Minimum magnitude homogenization

Results

- Grid with higher resolution
- More Intensity Measure Types
- Disaggregation results for main cities

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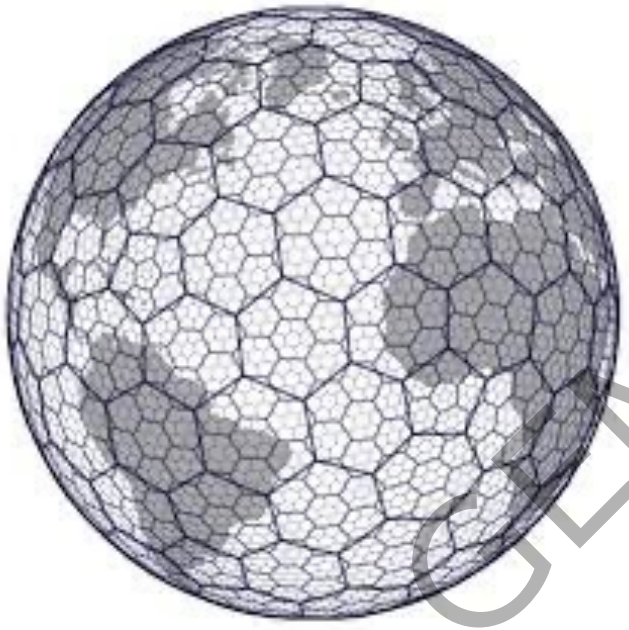
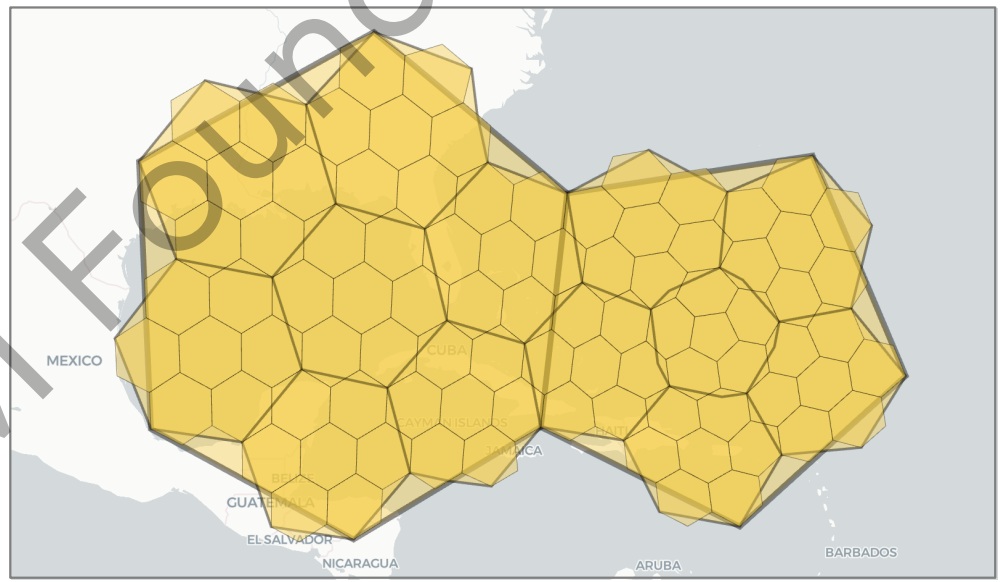
Hazard Maps Resolution

We abandoned the uniform grid of points created using in-house code in favor of the H3 library (https://h3geo.org/) and we increased the density of points





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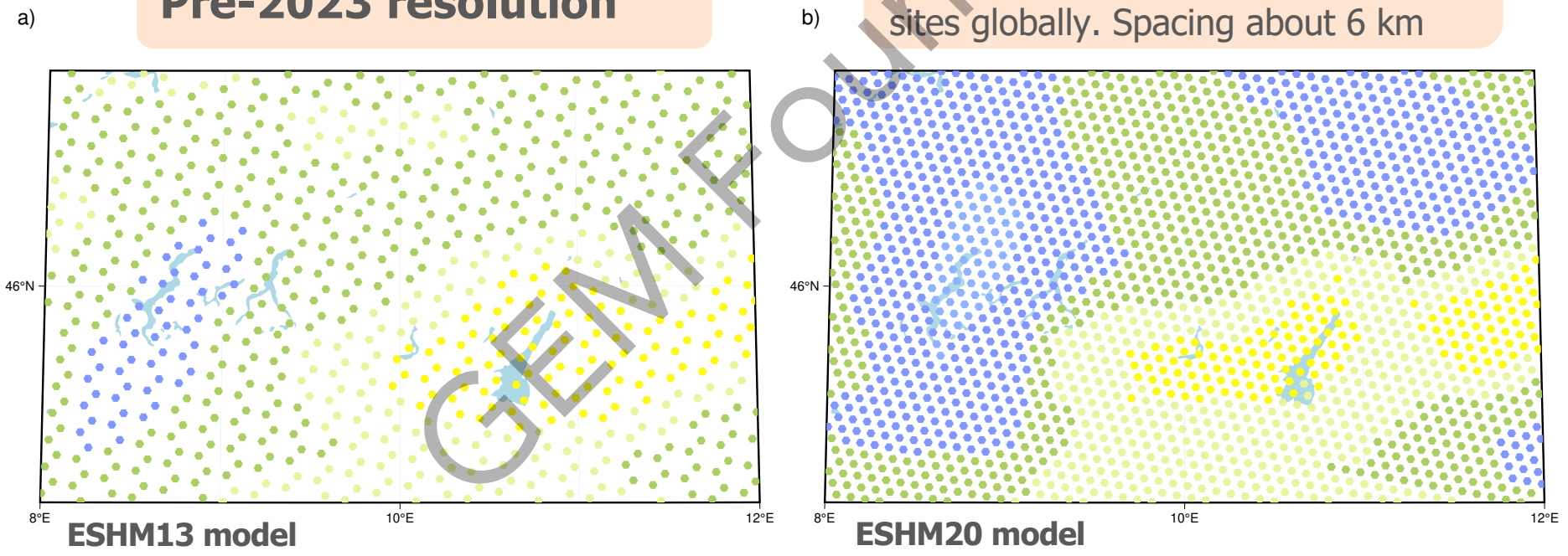
Hazard Maps Resolution (contd)

We abandoned the uniform grid of points created using in-house code in favor of the H3 library (https://h3geo.org/) and we increased the density of points

Pre-2023 resolution

New 2023 resolution

Hazard computed for about 4.5 M of sites globally. Spacing about 6 km



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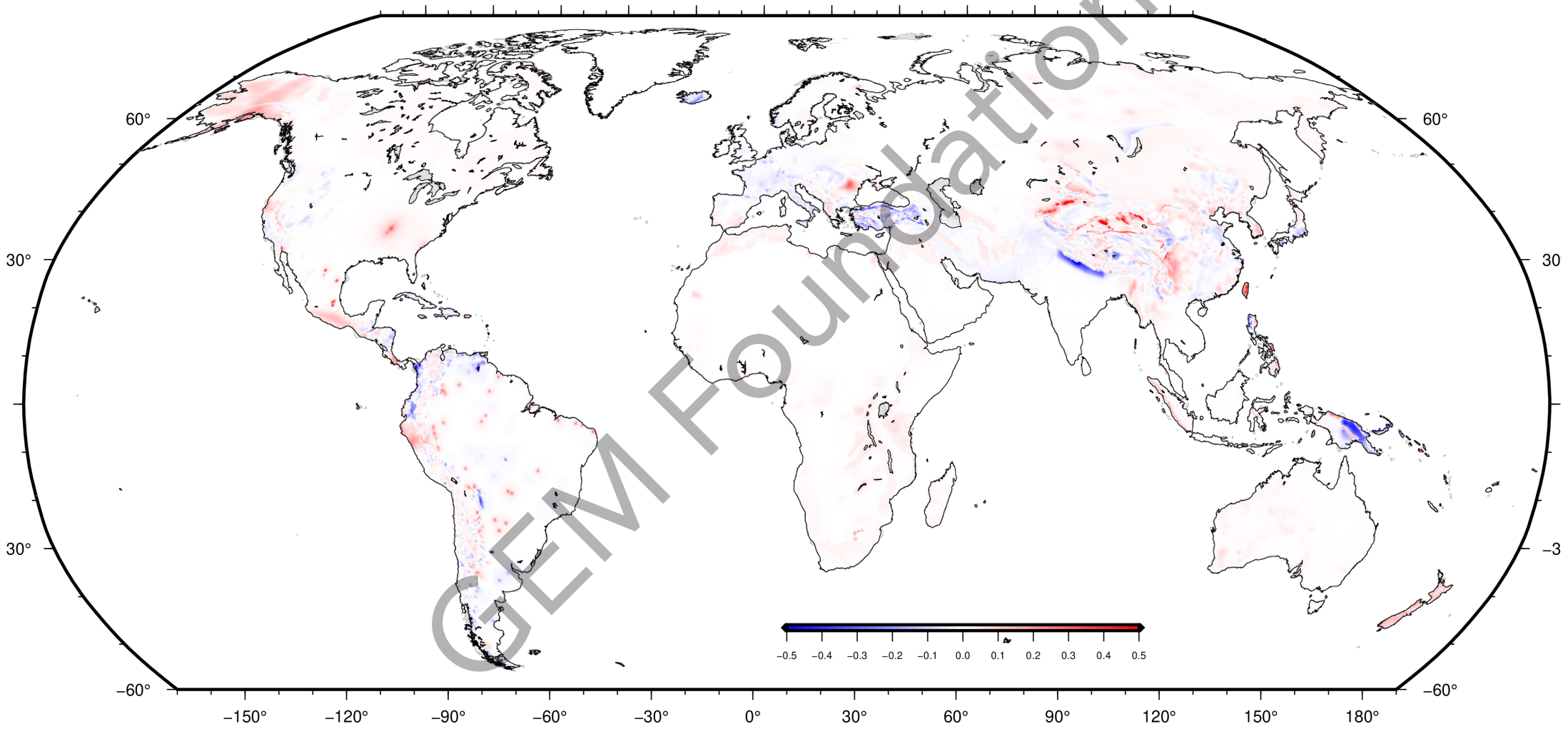
Difference map 2023 – 2018 (PGA 10% in 50yr on ref. rock)



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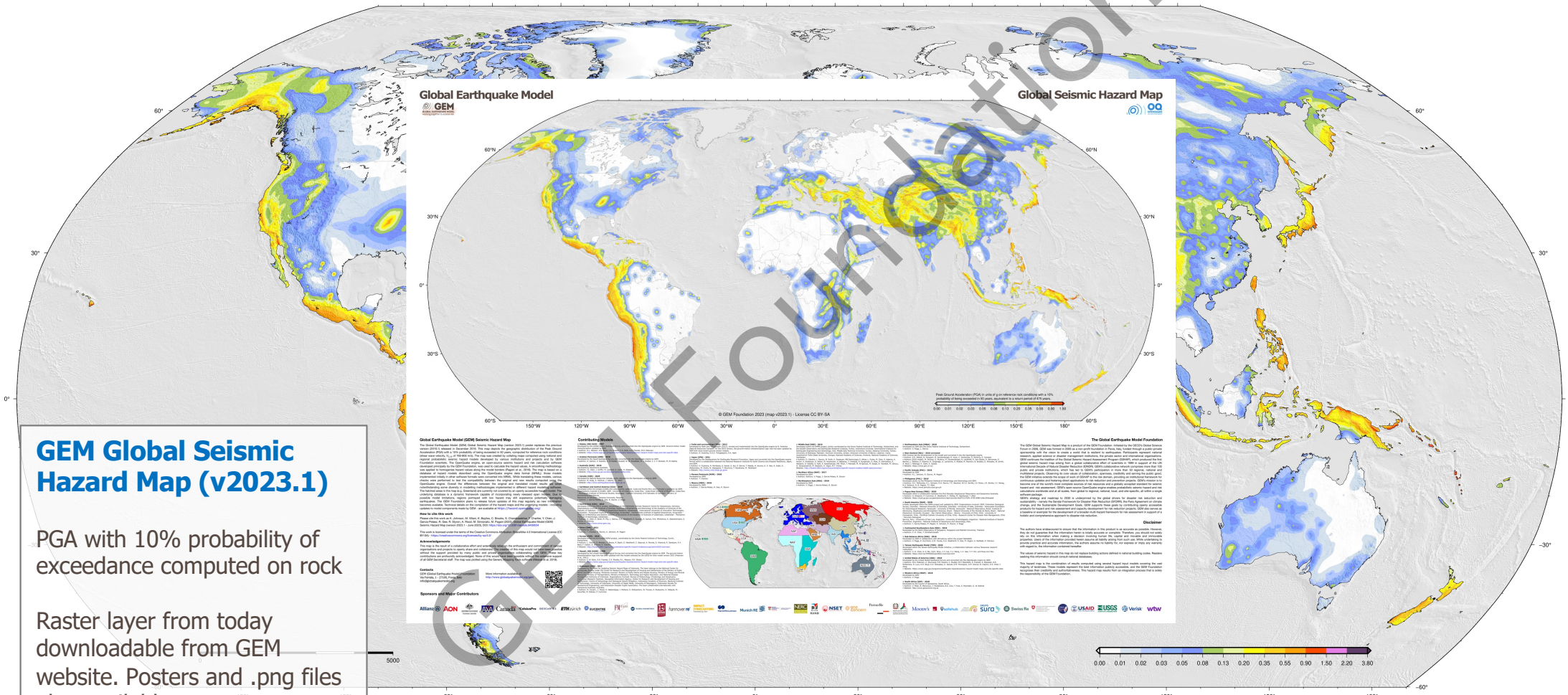
Global Seismic Hazard Maps



GEM Global Seismic Hazard Map (v2023.1)

PGA with 10% probability of exceedance computed on rock

Raster layer from today downloadable from GEM website. Posters and .png files also available.

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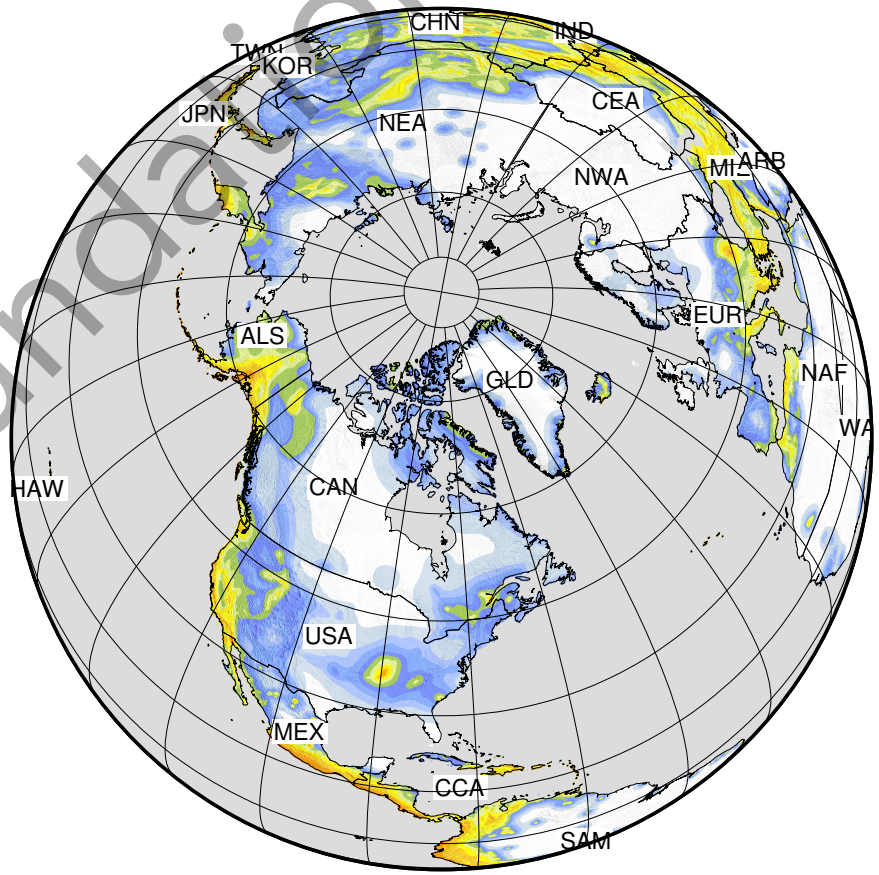
The GEM Global Mosaic: hazard results

- Results computed on reference rock conditions (i.e., 800 m/s) and on soil using the USGS Vs30 database
- Seismic Hazard Curves for PGA and Spectral Acceleration at 0.1, 0.2, 0.3, 0.6, 1.0 and 2.0 seconds
- Uniform Hazard Spectra and hazard maps for two return periods
- Seismic Hazard Disaggregation for main cities (5 IMTs and 2 PoEs)



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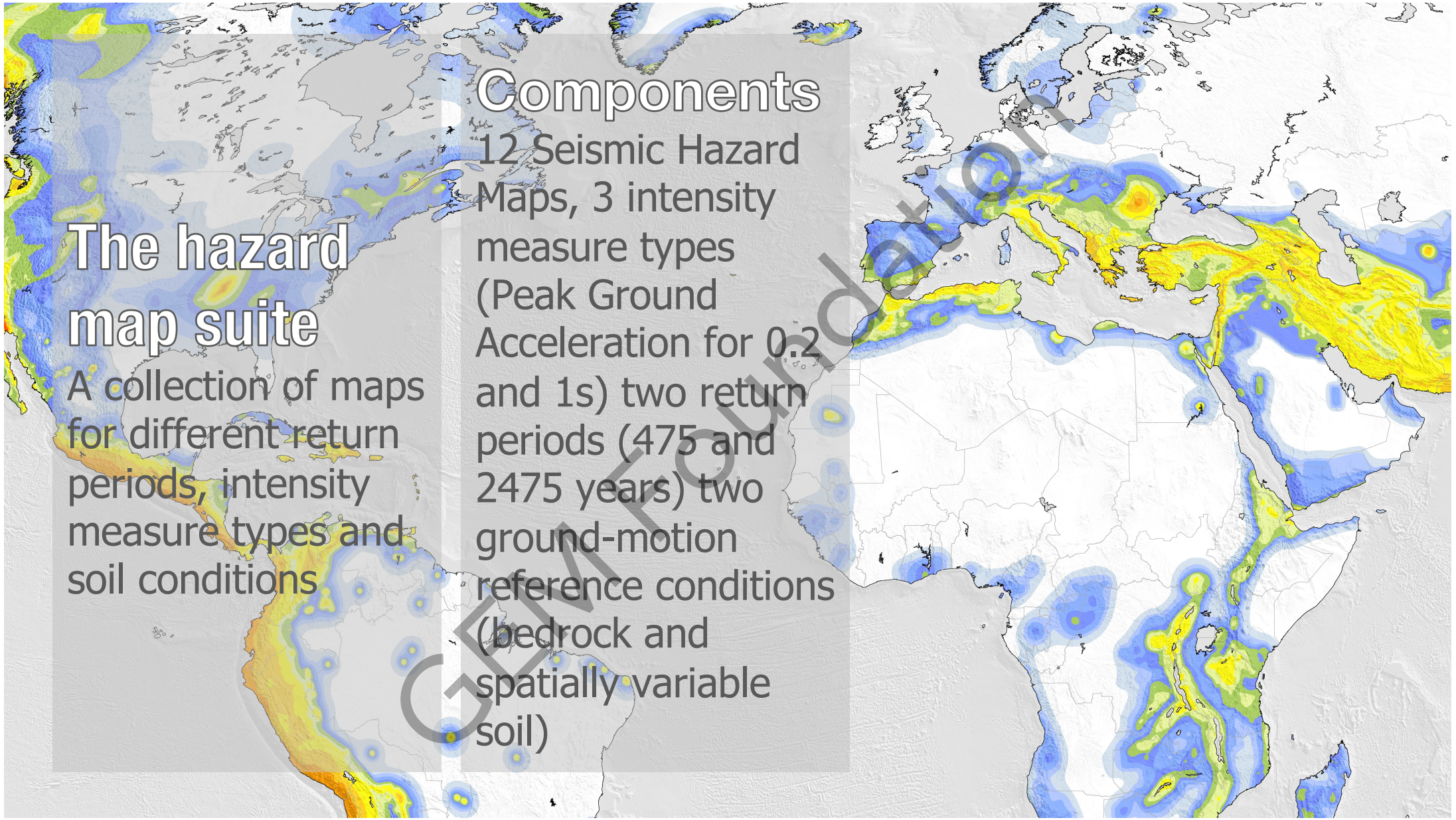
The hazard map suite
A collection of maps for different return periods, intensity measure types and soil conditions
Components
12 Seismic Hazard Maps, 3 intensity measure types (Peak Ground Acceleration for 0.2 and 1s) two return periods (475 and 2475 years) two ground-motion reference conditions (bedrock and spatially variable soil)
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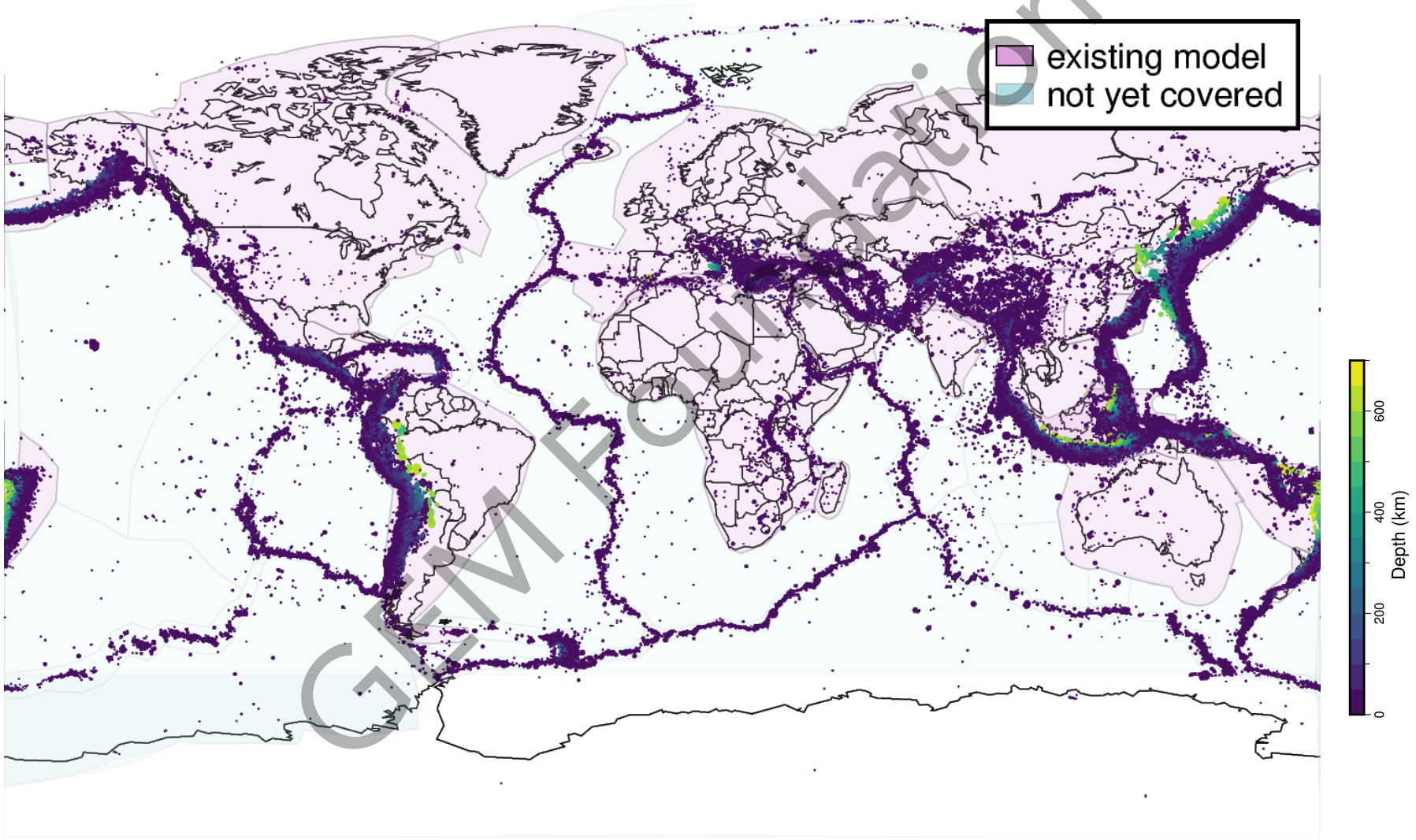
A Truly Global Model …



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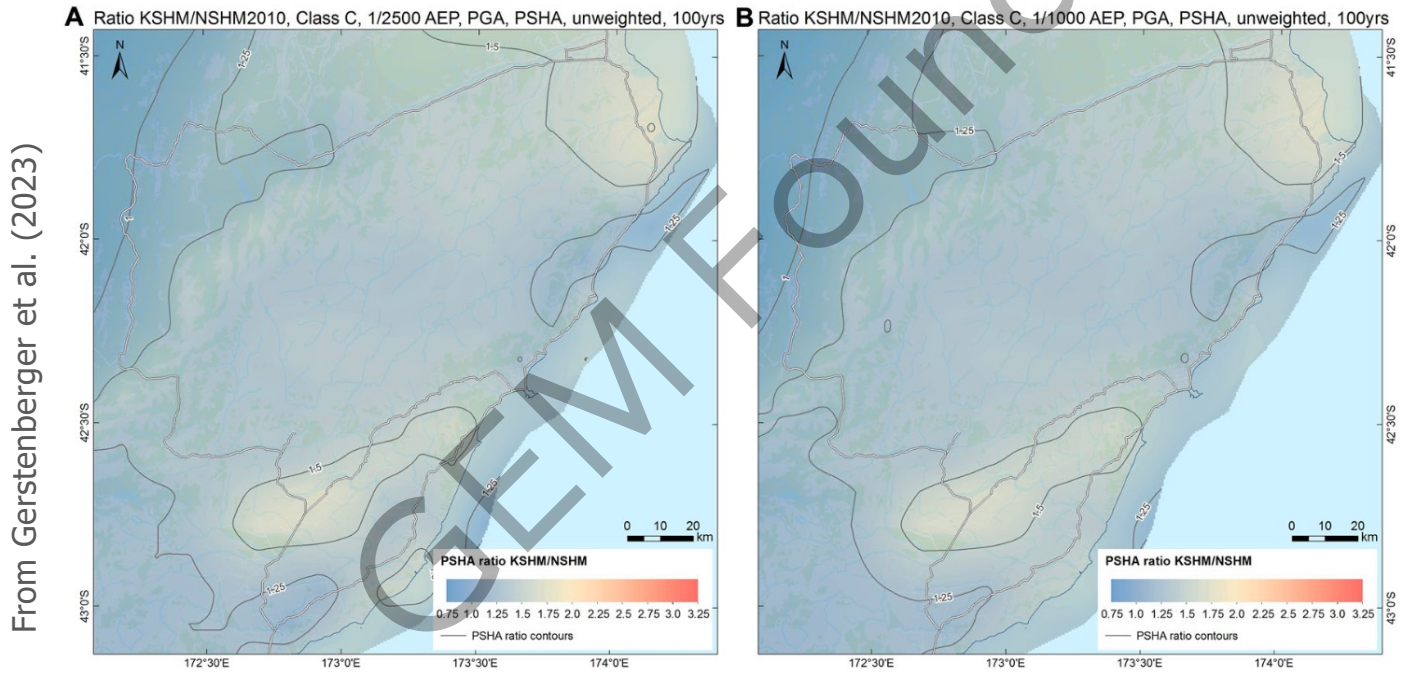
Time-dependence

- In various sectors there is an increasing interest to incorporate time dependence into hazard. We have ongoing activities for building new time-dependent models.



From Gerstenberger et al. (2023)

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Global Earthquake Scenarios (GEeSe) Project

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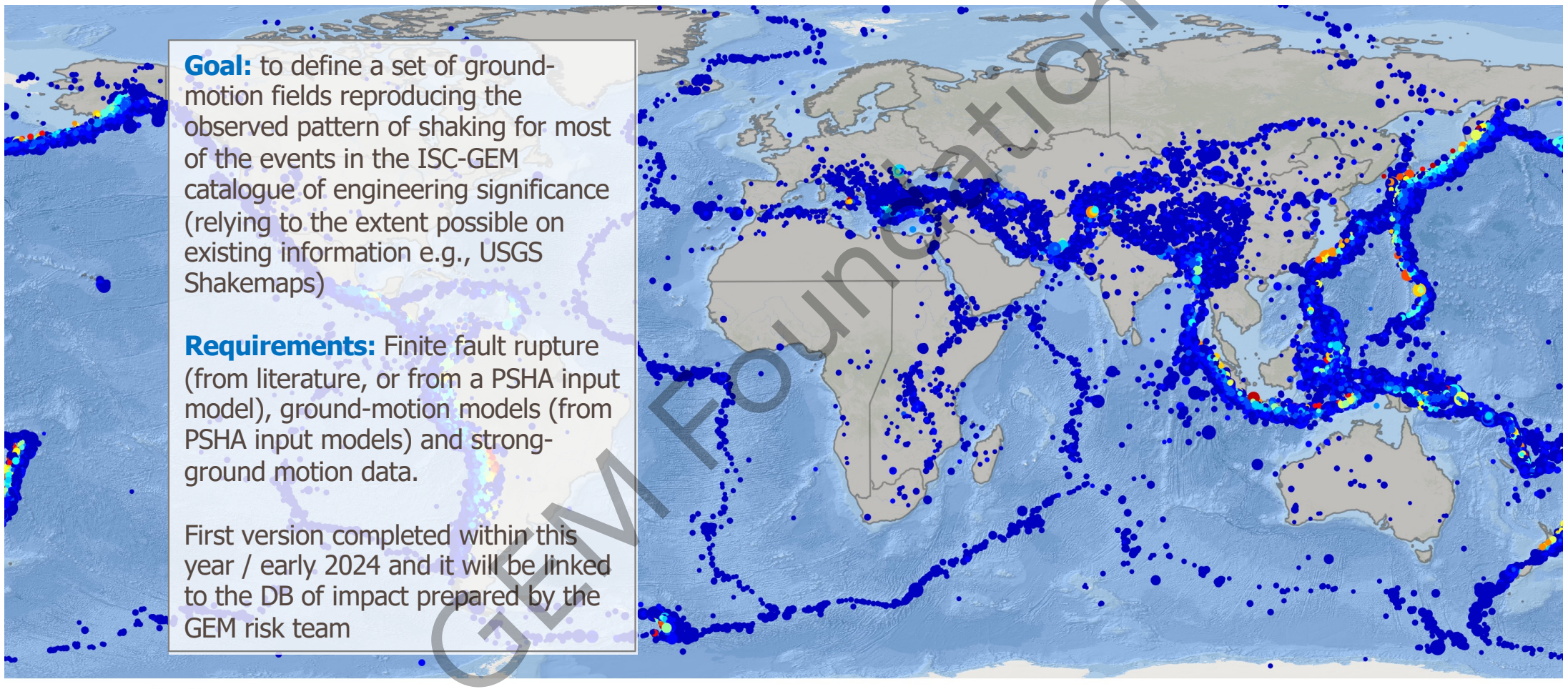

Goal: to define a set of ground-motion fields reproducing the observed pattern of shaking for most of the events in the ISC-GEM catalogue of engineering significance (relying to the extent possible on existing information e.g., USGS Shakemaps)

Requirements: Finite fault rupture (from literature, or from a PSHA input model), ground-motion models (from PSHA input models) and strong-ground motion data.

First version completed within this year / early 2024 and it will be linked to the DB of impact prepared by the GEM risk team

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ASCE Earthquake Loads Overseas (AELO) project

- Project carried out within a collaboration between the USGS and GEM and supported by U.S. DoS and DoD
- GOALs are:
  - To compute ASCE 7-16 and 41-17 design loads + subsequently ASCE 7-22 and 41-23 for a set of about 500 sites outside of US and distributed globally
  - To develop an web-based system that, given the coordinates of a site, can provide the information required to apply the building codes just described globally.

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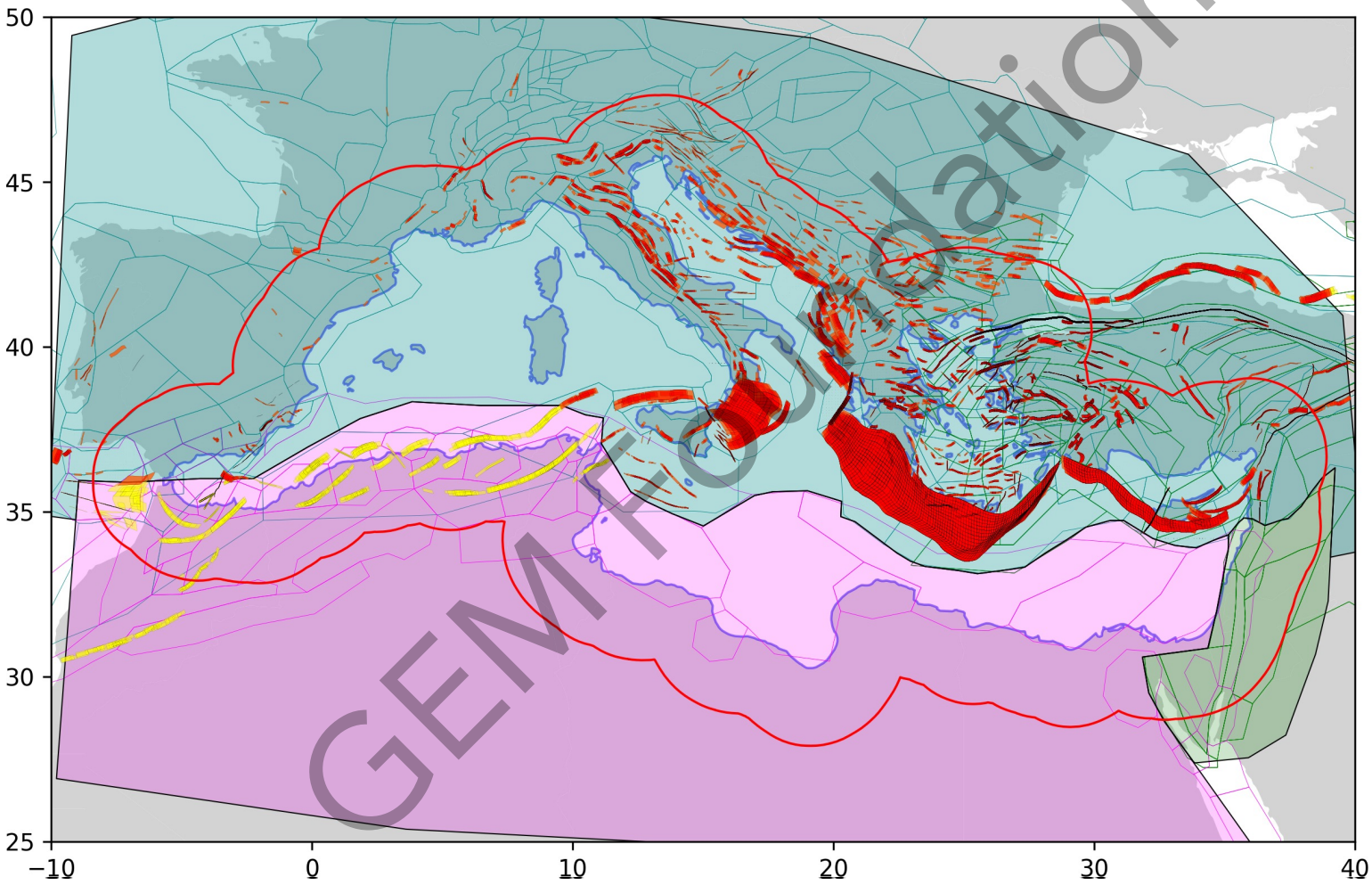
Toward a Global Stochastic Event Set



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Thank you!

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https://www.globalquakemodel.org

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