iASPEI!AGA
JOINT SCIENTIFIC MEETING LISBON 2025

IAGA / IASPEI Joint Scientific Meeting

31 August - 5 September 2025
Lisbon, Portugal

BOOK OF ABSTRACTS

IUGG IAGA International Association of Geomagnetism and Aeronomy

IUGG IASPEI International Association of Seismology and Physics of the Earth's Interior

iaga-iaspei-2025.org

Title: IAGA / IASPEI Joint Scientific Meeting 2025, 31 August – 5 September 2025,
Lisbon, Portugal: Book of Abstracts
Publisher: CZECH-IN s. r. o., 5. května 65, 140 00 Prague 4, Czech Republic
Issued: August 2025
1st edition

ISBN number: 978-80-909294-2-5

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AS25-0097

GIS-Based Project for SHA using the Unified Scaling Law for Earthquakes, Lake Baikal Region case study

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This study presents a GIS-based project for regional seismic hazard (SH) analysis, implemented in QGIS for the Lake Baikal region. The project consists of three components:

(i) *Identification of potential seismic sources*. SH is assessed using the Unified Scaling Law for Earthquakes (USLE), which generalises the Gutenberg–Richter law: $log_{10}N(M, L)=A+B\times(5–M)+C\times log_{10}L$, where $N(M, L)$ is the expected annual number of earthquakes of magnitude M in a region of linear size L, and A, B, and C are constants. A and B correspond to the a- and b-values of the Gutenberg–Richter relationship, while C reflects the local fractal dimension of earthquake epicentres. The multiscale USLE approach accounts for earthquake recurrence at different spatial scales, improving statistical estimates of rare high-magnitude events. A regional database of USLE coefficients (A, B, C) for grid cells (L_0=1/8°) is pre-installed in the project. The expected number of earthquakes of M_j over T years is: $N_T(M_j)=T\times N(M_j,L_0)$. The $max\{M_j\}$ satisfying $N_T(M_j)\geq p$ ($0\leq p\leq 1$) defines the Maximum Credible Earthquake (MCRE) serving as seismic intensity sources.

(ii) *Seismic Impact Modelling and Generation of seismic hazard maps (SHMs)*. A fast approximate method estimates macroseismic intensity, generating SHMs for 50 years with 10%, 5%, and 1% exceedance probabilities, considering fault strike, magnitude, and hypocentral distance.

(iii) *Verification and Comparison*. SHMs are compared with GSZ2016 and GEM2018 hazard maps and validated using 124 earthquakes (MLH≥5.5) from 3000BC to 2013AD.

The project is scalable and allowing integration of new data. It aimed to support scientific research and emergency management in earthquake-prone regions.