EGU26-3229, updated on 08 Nov 2026
https://doi.org/10.5194/egusphere-egu26-3229
EGU General Assembly 2026
© Author(s) 2026. This work is distributed under
the Creative Commons Attribution 4.0 License.

Influence of sources of epistemic uncertainties in hazard modeling on risk assessment: a regional assessment in Italy

Julián Montejo[1], Vitor Silva[1], and Bruno Pace[2]
[1]GEM Foundation, Risk Team, Pavia, Italy (julian.montejo@globalquakemodel.org)
[2]Università degli Studi "Gabriele d'Annunzio" di Chieti e Pescara, Chieti, Italy

Probabilistic Seismic Risk Analysis (PSRA) integrates seismic hazard with the vulnerability of exposed assets; however, the full propagation of uncertainties across this chain is still rarely examined. Although uncertainties affect hazard, vulnerability, and exposure models, most studies only partially address them, and end-to-end assessments remain limited. Epistemic uncertainty, arising from incomplete knowledge, is commonly represented through logic trees, which encode alternative modelling assumptions (e.g., recurrence models, maximum magnitudes) and define a discrete probability distribution over mutually exclusive options.

Previous studies suggest that hazard-related uncertainties often dominate seismic risk estimates, but few studies quantify this systematically, and is largely based on case studies from California. Within the TREAD project (tread-horizon.eu), we extend this understanding by applying a comprehensive framework to evaluate multiple sources of epistemic uncertainty using Italy, an earthquake-prone region, as both a national and regional case study.

We employ two alternative logic-tree structures: an area-source model with 540 branches and a combined fault-based plus smoothed-seismicity model with 243 branches. These configurations allow us to isolate the impact of choices related to slip rates, ground-motion models, scaling relations, recurrence behaviour, maximum-magnitude values, completeness methodologies, and site-specific assumptions.

Risk calculations are performed using the OpenQuake Engine, with structural economic losses adopted as the risk metric. Our results indicate that the dominant sources of epistemic uncertainty vary with the return period, implying that priorities for data acquisition and scientific investment should depend on the intended application of the risk results. Although ground-motion models often represent the largest contributor to epistemic uncertainty, our findings show that this assumption does not hold consistently across regions or return periods.