SESSION 39- Next-Generation Seismic and Multi-Hazard Risk Assessment: Secondary Perils and Climate Change Insights

Conveners
Svetlana Stripajova, Aon Impact Forecasting, Prague, Czechia
Shaghayegh Karimzadeh, University of Minho, Portugal
Sinan Akkar, T Rupt Technology Inc, Istanbul, Türkiye
Alexandra Carvalho, LNEC, Portugal
Marco Donà, University of Padova, Italy

Session Description

Earthquake risk assessment increasingly requires explicit consideration of cascading and secondary perils such as fire following, liquefaction, landslides, and tsunamis. These processes can account for a substantial share of total economic losses, yet they remain only partially represented in many operational earthquake risk and catastrophe modelling frameworks. At the same time, climate change is influencing precipitation patterns, sea levels, and soil conditions, thereby modifying the frequency, severity, and interactions of both primary and secondary hazards. The Kahramanmaraş earthquake sequence, Türkiye (2023), showcased nearly all secondary perils, with these contributing up to 20% of the overall losses. Together with the growing concentration and diversification of exposure in buildings, infrastructure networks, historical centres, and archaeological sites, this calls for more comprehensive and transparent multi-hazard risk assessment approaches.

Traditional seismic hazard and risk methodologies have provided the backbone of engineering practice and policy-making for decades. However, recent advances in catastrophe modelling, high-resolution data, remote sensing, GIS, and data-driven methods – including machine learning (ML) and artificial intelligence (AI) – offer powerful opportunities to improve the representation of complex hazard processes, better capture secondary and compound events, and narrow the protection gap between insured and total economic losses. ML and AI can systematically analyse terrain, soil, exposure and climate datasets, enabling finer-scale quantification of hazards such as liquefaction or landslide potential, as well as more accurate modelling of vulnerability and fire-following earthquake risk in urban areas.

This session aims to bring together catastrophe modelling practitioners, geoscientists, earthquake and geotechnical engineers, heritage and infrastructure experts, and data scientists to advance seismic and multi-hazard risk assessment frameworks that:

- explicitly model secondary, cascading, and compound perils within earthquake and multi-hazard risk models.
- integrate climate change impacts and emerging risks into hazard, exposure and vulnerability components.
- bridge traditional engineering and probabilistic approaches with ML/AI, remote sensing and GIS.
- support decision-making for risk mitigation, insurance, reinsurance, and public policy,

including applications to cultural heritage and critical infrastructure.

By fostering dialogue across disciplines and sectors, the session seeks to advance next-generation, robust and transparent models capable of representing multi-hazard, cascading and interacting risks in a changing climate, and to promote innovative, data-driven solutions for reducing both disaster impacts and the protection gap.

Topics include, but are not limited to:

- Classical and advanced single- and multi-hazard seismic risk assessment frameworks and cascading / compound events.
- Modelling and quantifying secondary perils (fire following, liquefaction, landslides, tsunami) in earthquake and multi-hazard catastrophe models.
- Integration of climate change effects into multi-hazard risk and loss models.
- Data-driven, ML and AI-based approaches for hazard, exposure and vulnerability assessment.
- Case studies on multi-hazard risk to buildings, infrastructure, historical centres and archaeological sites.