Global Seismic Risk Assessment: the Wrong, the Right, and the Truth.

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The increase in the global population, climate change, growing urbanization and settlement in regions prone to natural hazards are some of the factors contributing to the increase in the economic and human losses due to disasters. Earthquakes represent on average approximately one-fifth of the annual losses, but in some years this proportion can be above 50% (e.g. 2010, 2011). This impact can affect the sustainable development of society, creation of jobs and availability of funds for poverty reduction. Furthermore, business disruption of large corporations can result in negative impacts at global scale. Earthquake risk information can be used to support decision-makers in the distribution of funds for effective risk mitigation. However, open and reliable probabilistic seismic risk models are only available for less than a dozen of countries, which dampers disaster risk management, in particular in the under-developed world. To mitigate this issue, the Global Earthquake Model Foundation and its partners have been supporting regional programmes and bilateral collaborations to develop an open global earthquake risk model. These efforts led to the development of a repository of probabilistic seismic hazard models, a global exposure dataset, and a comprehensive set of fragility and vulnerability functions for the most common building classes. These components were used to estimate relevant earthquake risk metrics, which are now publicly available to the community.

The development of the global seismic risk model also allowed the identification of several issues that affect the reliability and accuracy of existing risk models. These include the use of outdated exposure information, insufficient consideration of all sources of epistemic and aleatory uncertainty, lack of results regarding indirect human and economic losses, and inability to forecast detailed earthquake risk to the upcoming decades. These challenges may render the results from existing earthquake loss models inadequate for decision-making. It is thus urgent to re-evaluate the current practice in earthquake risk loss assessment, and explore new technologies, knowledge and data that might mitigate some of these issues. A recent resource that can support the improvement of exposure datasets and the forecasting of exposure and risk into the next decades is the Global Human Settlement Layer, a collection of datasets regarding the built-environment between 1974 and 2010. The consideration of this type of information and incorporation of large sources of uncertainty can now be supported by artificial intelligence technology, and in particular open-source machine learning platforms. Such tools are currently being explored to predict earthquake aftershocks, to estimate damage shortly after the occurrence of destructive events, and to perform complex calculations with billions of simulations. These are examples of recent

resources that must be exploited for the benefit of improving existing risk models, and consequently enhance the likelihood that risk reduction measures will be efficient.

This study presents the current practice in global seismic risk assessment with all of its limitations, it discusses the areas where improvements are necessary, and presents possible directions for risk assessment in the upcoming years.