



## Development of multi-hazard exposure models from individual building observations for multi-risk assessment purposes

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The modelling of residential building portfolio exposure model for risk and loss estimations due to natural hazards often do not receive as much attention as other components in the risk chain (e.g. hazard intensity distribution, physical vulnerability). Large-scale (nation or region-wide) exposure models, for instance, are often based on information derived from census and aggregated over geographical administrative units. Moreover, it is customary to employ specific exposure/vulnerability schemas that entail a set of mutually exclusive, collectively exhaustive (MECE) building classes, each associated with a fragility/vulnerability model focusing on the specific reference hazard (e.g. HAZUS).

In order to improve the reliability of these models, particularly when the composition of the portfolio is expected to be heterogeneous, individual building observations may be required. This process is relevant in order to constrain and validate the underlying model assumptions. The assignment of single-hazard building classes within a given schema is usually obtained through expert elicitation (e.g., a skilled surveyor). However, if the very same building has to be classified under another vulnerability schema, either for the same hazard (e.g. EMS98 and HAZUS for seismic risk) or, in a multi-risk context, for a different hazard (e.g. tsunami, lahars), this might require a different expertise and the uncertainty of the resulting models could even increase.

We propose an innovative method to decouple the collection of exposure information from the development of exposure models in terms of specific vulnerability classes (schemas). Taking advantage of the methodology suggested by Pittore et al., 2018, individual building attributes are observed in the field for a set of surveyed buildings and described in terms of the GEM v2.0 taxonomy, a widely used and well-established faceted building taxonomy (Brzev et al., 2013). The assignment of a class is carried out in a post-processing stage and within a fully probabilistic framework by evaluating the level of compatibility between the observed building attributes and the classes available within the considered schema.

The proposed methodology has been exemplified in Chile and Peru within the framework of the RIESGOS project. Expert structural engineers from CIGIDEN (Chile) and the Universidad de la Sabana (Colombia) carried out a Rapid Remote Visual Screening Survey using the RRVS web tool (e.g. Haas et al., 2016). In the case of seismic risk we focused on three schemas, namely SARA (a custom schema developed within the GEM-SARA Project in South America), and the well-known EMS-98 and HAZUS. The tsunami-focused schema proposed by Suppasri et al. (2013) has been also implemented.

Preliminary results for Gran Valparaiso (Chile) and Metropolitan Lima (Peru) study areas show the potential of the proposed methodology for streamlining the development of multi-hazard exposure models and significantly improving the transparency of the risk assessment procedures and the propagation of related uncertainties. The importance of extending the building taxonomy to encompass multi-hazard attributes is also discussed.