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Modular Exposure Disaggregation Methodologies for Catastrophe Modelling using GIS and Remotely-Sensed Data

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Loss estimates produced by catastrophe models are dependent on the quality of the input data, including both the hazard and exposure data.
Currently, some of the exposure data input into a catastrophe model is aggregated over an area and therefore an estimate of the risk in this area may have a low level of accuracy. In order to obtain a more detailed and accurate loss estimate, it is necessary to have higher resolution exposure data. However, high resolution exposure data is not commonly available worldwide and therefore methods to infer building distribution and characteristics at higher resolution from existing information must be developed. This study is focussed on the development of disaggregation methodologies for exposure data which, if implemented in current catastrophe models, would lead to improved loss estimates.
The new methodologies developed for disaggregating exposure data make use of GIS, remote sensing and statistical techniques. The main focus of this study is on earthquake risk, however the methods developed are modular so that they may be applied to different hazards. A number of different methods are proposed in order to be applicable to different regions of the world which have different amounts of data available. The new methods give estimates of both the number of buildings in a study area and a distribution of building typologies, as well as a measure of the vulnerability of the building stock to hazard. For each method, a way to assess and quantify the uncertainties in the methods and results is proposed, with particular focus on developing an index to enable input data quality to be compared.
The applicability of the methods is demonstrated through testing for two study areas, one in Japan and the second in Turkey, selected because of the occurrence of recent and damaging earthquake events. The testing procedure is to use the proposed methods to estimate the number of buildings damaged at different levels following a scenario earthquake event. This enables the results of the models to be compared with real data and the relative performance of the different methodologies to be evaluated. A sensitivity analysis is also conducted for two main reasons. Firstly, to determine the key input variables in the methodology that have the most significant impact on the resulting loss estimate. Secondly, to enable the uncertainty in the different approaches to be quantified and therefore provide a range of uncertainty in the loss estimates.