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# Remote sensing and earthquake risk: A (re)insurance perspective

Anselm Smolka and Andreas Siebert
Munich Re, Munich, Germany (asmolka@munichre.com)

The insurance sector is faced with two issues regarding earthquake risk: the estimation of rarely occurring losses from large events and the assessment of the average annual net loss. For this purpose, knowledge is needed of actual event losses, of the distribution of exposed values, and of their vulnerability to earthquakes. To what extent can remote sensing help the insurance industry fulfil these tasks, and what are its limitations?

In consequence of more regular and high-resolution satellite coverage, we have seen earth observation and remote sensing methods develop over the past years to a stage where they appear to offer great potential for addressing some shortcomings of the data underlying risk assessment. These include lack of statistical representativeness and lack of topicality. Here, remote sensing can help in the following areas:
• Inventories of exposed objects (pre- and post-disaster)
• Projection of small-scale ground-based vulnerability classification surveys to a full inventory
• Post-event loss assessment
But especially from an insurance point of view, challenges remain. The strength of airborne remote sensing techniques lies in outlining heavily damaged areas where damage is caused by easily discernible structural failure, i.e. total or partial building collapse. Examples are the Haiti earthquake (with minimal insured loss) and the tsunami-stricken areas in the Tohoku district of Japan. What counts for insurers, however, is the sum of monetary losses. The Chile, the Christchurch and the Tohoku earthquakes each caused insured losses in the two-digit billion dollar range. By far the greatest proportion of these insured losses were due to non-structural damage to buildings, machinery and equipment. Even with the Tohoku event, no more than 30% of the total material damage was caused by the tsunami according to preliminary surveys, and this figure includes damage due to earthquake shock which was unrecognisable after the passage of the tsunami. Non-structural damage is invisible in airborne surveys, and this also applies to the majority of so-called constructive total losses in liquefied areas, including the Central Business District in Christchurch. Nonetheless, aerial and satellite photos have been of great assistance in mapping out the areas affected by liquefaction in Christchurch and by the tsunami in Tohoku/Japan, and in this respect provided useful hints regarding the extent of heavily damaged areas. But to unfold their full potential, traditional airborne surveys must be supplemented by efficient ground-based surveys supported by mobile terrestrial vehicles, unmanned aerial vehicles (UAV) and random sample on-site inspections.

The situation is similar with regard to compiling inventories of buildings. To achieve a realistic building typology, seismic vulnerability classification and occupancy classes, satellite data must be supported by field surveys, additional geospatial datasets and on-site engineering know-how. Here, 3D LIDAR-based city models are also a promising additional means of improving the overall risk assessment by supplying more geometrical parameters (e.g. plan, height and number of storeys). Finally, high-resolution imagery still provides excellent “background” information for improved risk transparency within the risk dialogue with industry and public authorities.

Even more difficult is another problem which is specifically related to insurance practice. Depending on the country and the region concerned, only a variable fraction of exposed objects (and losses) is insured, so how can the overall information on inventories and losses be correlated to the insured portion? Except for areas with very high insurance penetration, any technique based on remote sensing has reached its limit of applicability.