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Assessing hail risk for a building portfolio by generating stochastic events

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Among the natural hazards affecting buildings, hail is one of the most costly and is nowadays a major concern for building insurance companies. In Switzerland, several costly events were reported these last years, among which the July 2011 event, which cost around 125 million EUR to the Aargauer public insurance company (North-western Switzerland). This study presents the new developments in a stochastic model which aims at evaluating the risk for a building portfolio.

Thanks to insurance and meteorological radar data of the 2011 Aargauer event, vulnerability curves are proposed by comparing the damage rate to the radar intensity (i.e. the maximum hailstone size reached during the event, deduced from the radar signal). From these data, vulnerability is defined by a two-step process. The first step defines the probability for a building to be affected (i.e. to claim damages), while the second, if the building is affected, attributes a damage rate to the building from a probability distribution specific to the intensity class.

To assess the risk, stochastic events are then generated by summing a set of Gaussian functions with 6 random parameters (X and Y location, maximum hailstone size, standard deviation, eccentricity and orientation). The location of these functions is constrained by a general event shape and by the position of the previously defined functions of the same event. For each generated event, the total cost is calculated in order to obtain a distribution of event costs. The general events parameters (shape, size, ...) as well as the distribution of the Gaussian parameters are inferred from two radar intensity maps, namely the one of the aforementioned event, and a second from an event which occurred in 2009.

After a large number of simulations, the hailstone size distribution obtained in different regions is compared to the distribution inferred from pre-existing hazard maps, built from a larger set of radar data. The simulation parameters are then adjusted by trial and error, in order to get the best reproduction of the expected distributions. The value of the mean annual risk obtained using the model is also compared to the mean annual risk calculated using directly the hazard maps.

According to the first results, the return period of an event inducing a total damage cost equal or greater than 125 million EUR for the Aargauer insurance company would be of around 10 to 40 years.