

Simulation of extreme events in the presence of spatial dependency

The Canadian damage insurance market is undergoing changes and several companies are starting to offer protection against flooding.

Protections were already available against flooding caused by rain or sewer backup. The new protections are rather against flooding caused by stream overflows (i.e., river flooding) or coastal flooding.

For this kind of damage, insurers generally use models of disasters that take into account variables related to the disaster (rain, flow rate, wind, waves) and compute the losses on affected structures that are associated with these events. There are two kinds of models : the deterministic models and the stochastic models.

In the context of river flooding, the so-called deterministic models start by creating maps indicating the water level at each point, for a flood with a given probability (i.e., 1% or once in 100 years). Some of these models will then determine the link between the water level at a given site and the damage to the structure for this event.

On the other hand, the stochastic models simulate a very large number of events and for each one of them, they determine the water level at each point as well as the damage to the affected structures. After this step the models can create a flooding map for every occurrence probability.

The main benefit of stochastic models is that they allow us to obtain more precise measurements of the potential damage to structures, thanks to a distribution of results that is much more complete.

In stochastic models, several methods may be used to simulate events. Among the interesting methods, let us mention an approach based on vine copulas : its main advantage is that it takes into account the spatial correlation structure of events.

Desjardins wishes to develop a stochastic model for coastal flooding. The available data come from buoys distributed in a very unequal fashion along the coast and on the high sea. The period during which a buoy is in use varies a lot from one buoy to the next. Some buoys have been in use for a very short period, while others have been in use for several tens of years. It is expected that there will be a strong correlation between the buoys that are close to one another. The goal of the project is to generate a large number of events by using the data collected on buoys.