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Comparative risk assessments for the city of Pointe-à-Pitre (French West Indies): earthquakes and storm surge

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In France, risk assessments for natural hazards are usually carried out separately and decision makers lack comprehensive information. Moreover, since the cause of the hazard (e.g. meteorological, geological) and the physical phenomenon that causes damage (e.g. inundation, ground shaking) may be fundamentally different, the quantitative comparison of single risk assessments that were not conducted in a compatible framework is not straightforward.

Comprehensive comparative risk assessments exist in a few other countries. For instance, the Risk Map Germany project has developed and applied a methodology for quantitatively comparing the risk of relevant natural hazards at various scales (city, state) in Germany. The present on-going work applies a similar methodology to the Pointe-à-Pitre urban area, which represents more than half of the population of Guadeloupe, an overseas region in the French West Indies. Relevant hazards as well as hazard intensity levels differ from continental Europe, which will lead to different conclusions.

French West Indies are prone to a large number of hazards, among which hurricanes, volcanic eruptions and earthquakes dominate. Hurricanes cause damage through three phenomena: wind, heavy rainfall and storm surge, the latter having had a preeminent role during the largest historical event in 1928. Seismic risk is characterized by many induced phenomena, among which earthquake shocks dominate.

This study proposes a comparison of earthquake and cyclonic storm surge risks. Losses corresponding to hazard intensities having the same probability of occurrence are calculated. They are quantified in a common loss unit, chosen to be the direct economic losses. Intangible or indirect losses are not considered. The methodology therefore relies on (i) a probabilistic hazard assessment, (ii) a loss ratio estimation for the exposed elements and (iii) an economic estimation of these assets.

Storm surge hazard assessment is based on the selection of relevant historical cyclones and on the simulation of the associated wave and cyclonic surge. The combined local sea elevations, called “set-up”, are then fitted with a statistical distribution in order to obtain its time return characteristics. Several run-ups are then extracted, the inundation areas are calculated and the relative losses of the affected assets are deduced.

The Probabilistic Seismic Hazard Assessment and the exposed elements location and seismic vulnerability result from past public risk assessment studies. The loss estimations are computed for several return time periods, measured in percentage of buildings being in a given EMS-98 damage state per grid block, which are then converted into loss ratio.

In parallel, an asset estimation is conducted. It is mainly focused on private housing, but it considers some major public infrastructures as well. The final outcome of this work is a direct economic loss-frequency plot for earthquake and storm surge. The Probable Maximum Loss and the Average Annual Loss derivate from this risk curve.

In addition, different sources of uncertainty are identified through the loss estimation process. The full propagation of these uncertainties can provide an interval of confidence, which can be assigned to the risk-curve and we show how such additional information can be useful for risk comparison.