Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01208, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01208
EGU General Assembly 2008
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A probabilistic local-scale multi-risk analysis

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Multi-risk assessment is a promising tool for territorial planning, emergency management and mitigation strategies development.

We performed a quantitative probabilistic multi-risk analysis (QPRA) at the local scale for a 420 km2 area surrounding the town of Brescia (Northern Italy).

We calculated the expected annual loss for a set of risk scenarios of flood, landslide, earthquake and industrial accident with different probability and different intensity. We based the analysis on F/N and vulnerability curves that describe the expected level of damage as a function of the intensity of risk scenario. To integrate the different risks, we considered domino and feedback effects.

Due to the intrinsic uncertainty of the analysis, we developed a probabilistic treatment that describes the reliability of the output (risk) as a function of the uncertainty of the inputs (scenarios and vulnerability functions). In particular, we applied both Monte Carlo simulation and First Order Second Moment (FOSM) methods in the evaluation of the hazards, the value of the exposed elements (e.g., residential and industrial area, population, lifelines, sensitive elements as schools, hospitals) and the process-specific vulnerability.

As a result, we quantified and compared the annual losses due to each risk scenario through loss-probability curves, and we quantified the degree of uncertainty.

We observed that the expected loss due to earthquake occurrence on the study area is higher than what expected for the other events: for a recurrence interval of 2475 years, the estimated loss amounts to 95.700.000 euros.

The industrial risk has a secondary role in the area, if we don’t consider the domino effects, due to its low occurrence probability and to its limited area of impact.