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Tsunami hazard and risk assessment in El Salvador

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Tsunamis are relatively infrequent phenomena representing a greater threat than earthquakes, hurricanes and tornadoes, causing the loss of thousands of human lives and extensive damage to coastal infrastructure around the world. Several works have attempted to study these phenomena in order to understand their origin, causes, evolution, consequences, and magnitude of their damages, to finally propose mechanisms to protect coastal societies. Advances in the understanding and prediction of tsunami impacts allow the development of adaptation and mitigation strategies to reduce risk on coastal areas.

This work -Tsunami Hazard and Risk Assessment in El Salvador-, funded by AECID during the period 2009-12, examines the state of the art and presents a comprehensive methodology for assessing the risk of tsunamis at any coastal area worldwide and applying it to the coast of El Salvador. The conceptual framework is based on the definition of Risk as the probability of harmful consequences or expected losses resulting from a given hazard to a given element at danger or peril, over a specified time period (European Commission, Schneiderbauer et al., 2004).

The HAZARD assessment (Phase I of the project) is based on propagation models for earthquake-generated tsunamis, developed through the characterization of tsunamigenic sources -sismotectonic faults- and other dynamics under study -tsunami waves, sea level, etc.-. The study area is located in a high seismic activity area and has been hit by 11 tsunamis between 1859 and 1997, nine of them recorded in the twentieth century and all generated by earthquakes. Simulations of historical and potential tsunamis with greater or lesser affection to the country's coast have been performed, including distant sources, intermediate and close. Deterministic analyses of the threats under study -coastal flooding- have been carried out, resulting in different hazard maps (maximum wave height elevation, maximum water depth, minimum tsunami arrival time, maximum flooding level or "Run-up", hazard degree for people based on incipient velocity for people instability) along the coast of El Salvador and at some relevant locations (high resolution analysis). The VULNERABILITY assessment of the exposed elements (Phase II of the project) is based on an integrated approach which is essential given the complexity of coastal areas. A set of indices and indicators have been developed supported by a Geographic Information System that allows graphical representation of physical, environmental, social, economic and infrastructure characteristics of the coast. Different spatial and temporal scales have been also considered in this project to calculate the risk, since both factors would change the amount and type of exposed elements and their vulnerability.

A final global RISK analysis (hazard, exposure and vulnerability analysis for each dimension -human, environmental, socioeconomic and infrastructure- and both temporal and spatial scales) allows identifying weaknesses, gaps and special needs to cope with a tsunami event and, therefore, will result in a set of risk reduction measures, including adaptation and mitigation measures.