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# Risk assessment to extreme wave events using GIS: the first step for disaster risk reduction in coastal zones

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A scientific consensus exists regarding the significant impacts of global climate change over coastal zones. These impacts includes sea level rise, variability in the patterns of rainfall and runoff and changes in frequency, intensity and duration of extreme wave events. The study of the relationships existing between littoral transformation and climate change - with associated hazards, vulnerabilities and risks - represents the first step in the design of adaptation plans for coastal zones (risk reduction). Risk assessments provide information on the pressure to which the coastal zone is exposed and its adaptive capacity. In this kind of assessments, it is important to examine interacting physical attributes and socioeconomic, conservational and archeological–cultural characteristics. It is urgently required to develop reliable assessment and mitigation tools to reduce the risk associated to storms. The determination of coastal susceptibility or vulnerability is an important instrument for managers/planners for coastal preservation, protection and development, as vulnerability outcomes provide baseline information and a scientific basis for any envisaged coastal erosion management plan and mitigation measures under sustainability aspects. This work deals with a methodological approach to the risk determination for sand and cliff coasts to extreme wave events impacts. The approach is based on the selection and evaluation of three types of variables: i) the forcing variables contributing to extreme waves-induced erosion, ii) dynamic variables that determine the resilience to erosion (Susceptibility) and iii) the vulnerable targets grouped in three different contexts (socio-economic, ecological and heritage). These are combined into two separate indices, the Hazard Index (combining forcing and susceptibility) and the Vulnerability Index, which together constitute the Coastline Risk Index as a single numerical measure of the risk for a given area. Proposed methodology has been tested in two coastal strips located on the Caribbean coast of Colombia (Cartagena city and along Boca de Cenizas - Rio Piedras sector). Results obtained in both coastal systems reveal that there are several vulnerable areas that have very dynamic processes, such as extremely high evolution rates. Hazard, vulnerability and risk maps generated with this methodology can be used as a guideline contributing to the determination of causes, processes and consequences derived from the storm associated processes. The information derived by the use of the proposed methodology in this work may have direct applications in future coastal development programs and, at the same time, can assist decision-makers in the implementation of preventive management strategies for most sensitive areas in order to reduce risk.