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Can satellite remote sensing methods provide reliable alternatives? A critical review of single and multi-hazard risk assessments

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Can satellite remote sensing data provide reliable alternatives for multi-hazard assessments? For several years, the incorporation of such methods has been growing in single-hazard risk assessments, but multi-hazard approaches, despite being demonstrated as attractive solutions, are still lacking developments in this area.
This paper is a review of methods used to assess weather-driven hazards, with an innovative orientation to the potential of integration of satellite remote sensing methods as the main (or exclusive) data source. The discussion is aimed for a further application in the Aveiro Region study area, a complex socioecological system, located in north-western coast of Portugal's mainland, on the border between Temperate Mediterranean and Atlantic biogeographical regions. The focus of this review is made on the main hazard sources affecting such regions, including wildfires, soil erosion and floods (fluvial and coastal), by comparing both single and multi-hazard approaches.
The methodological review includes a description of each method, according to their category of hazard source. The choice of methods ranges from whole risk assessments, hazard exposure simulation models, event-damage estimation methods, or sets of vulnerability indicators. Each method reference contains the main purpose of application, corresponding bibliographic sources and year of implementation, data requirements, scale of application and geographical scope. Moreover, it identifies the specific advantages and disadvantages, with particular focus on their potential for exclusive use of remote sensing data. Whenever applicable, they are categorized as being a mathematical statistical, or physically based model (either deterministic or probabilistic).
The study area-oriented discussion focuses on the trade-offs between data requirements and output accuracy, addressing the major benefits and constrains learn from previous studies. Additionally, it addresses specific constrains and potential of application in Portugal, with particular emphasis on data availability, therefore indicating potential sources of open access data and resources.
Despite the relative lack of consistent multi-hazard studies, this paper discusses the alternatives about data integration handling and how superficial or specific their outcome might be. It recognises some of the difficulties inherent to the multiplicity of scientific areas involved and the complexity in their interpretation, and their application in already complex socioecological systems, which represent additional challenges.
This investigation confirms that satellite remote sensing methods are capable of providing enough data to perform primary multi-hazard analysis. By combining some of the methods included in this review, in some cases with further simplifications, these can be particularly useful for primary assessments and at regional scales.