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Development of a stream flood susceptibility index at the municipal level in mainland Portugal

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The growing computational capabilities and data availability promotes the development of flood susceptibility methodologies, although there is still field for improvement regarding small-scale flood susceptibility assessment. In this research, after assessing a national stream flood susceptibility (SFS) on a cell-by-cell basis, a municipal representation of SFS was performed to rank the 278 municipalities in mainland Portugal.
Three flood conditioning factors were used: flow accumulation and average slope angle obtained from a digital elevation model (DEM); and the average inverse relative permeability, obtained from dominant parent material, fine fraction of the topsoil and land use data. All the values were transformed to the range [0, 10].
The innovative aspect of this method relies on the fact that it considers the cumulative function in regard to all flood conditioning factors, thus considering the entire contributive area of flow, slope and permeability in each cell and not only the on-site characteristics. This implied the collection of data from the transboundary basins.
Based on previous applications of the method in Portugal, three models (A, B and C) were defined using distinct weights for the conditioning factors. The final susceptibility index is obtained from the sum of the product between the value of each conditioning factor and its respective weight. SFS values less than 5 were excluded as they identify hill-tops, slopes and small streamlines.
Historical flood databases such as the DISASTER database and other flood documental databases were used to select the best combination of flood conditioning factors' weights, upon correlation with the respective SFS values to which flood disasters are associated. Flood susceptibility obtained from model C, that valued more the flow accumulation factor, presents the best fit with the historical records in almost all the four validation areas. It assigns a weight of 0.85 to flow accumulation, 0.1 to slope and 0.05 to relative permeability.
Using those values, a mean SFS by municipality was calculated and cross-analysed with the historical municipal record of flood impacts, contributing to the definition of municipal flood risk profiles. Some profiles identify municipalities where flood issues are almost negligible, whether by a low natural susceptibility or a low exposure. Some municipalities present a severe record of flood impacts regardless of low SFS values. In such cases, risk-related policies must aim to a long-term reduction in exposure through spatial planning, for example. On the other hand, there are municipalities with high SFS values but a low record of flood impacts. These cases must be analysed in order to identify the best practices and the geographical contexts, which might explain such favourable output.
The presented approach can be applied in the national-scale preliminary phases of flood risk management processes, understanding flood susceptibility and supporting the posterior allocation of resources.

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