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Physical vulnerability of buildings exposed to different flood hazards in the Lisbon Metropolitan Area

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This work aims to assess the spatial relationships between buildings and the flood risk areas identified in the Floods Directive. The assessment considers the physical vulnerability of the buildings (from seven parameters regarding their physical properties and implantation), the flood hazard (considering the flood height and the runoff velocity) and the geomorphological context of the building's implantation areas. The test sites are the areas of significant potential flood risk (ASPFR) existing in the Lisbon Metropolitan Area (LMA), and being evaluated in the 2nd implementation cycle of the Floods Directive, which includes flooding of the fluvial, estuarine and coastal type:

- V.F. Xira-Tagus estuary: fluvial, estuarine and coastal flooding affecting the Tagus river, its estuary, to the oceanic shoreline of the Cascais and Almada municipalities;

- Loures-Odivelas: fluvial flooding in the Trancão river, a tributary of the Tagus river;

- Cova do Vapor-Fonte da Telha: coastal flooding in the Almada municipality;

- Seixal: fluvial and estuarine flooding in the Judeu river, affecting the Seixal municipality;

- Setúbal: fluvial flooding in the Livramento stream, affecting the Setúbal municipality;

The assessment of the physical vulnerability of buildings (PVB) to flooding considered all the buildings with residential function surveyed in the 2011 Census survey (Georeferenced Buildings Database). The assessment considers six building parameters, namely the period of construction, number of storeys, material of external cladding, material of structural system, building exposure, building condition, and one defined by the spatial framing of the building in the soil/lithological substrate. A score between 10 and 100 is given to each building according to its characteristics expressed in four classes. Both scores and parameters' weights are based on expert opinion and dedicated literature.

This analysis aims at verifying to what extent: (i) the buildings' characteristics make them adapted to the characteristics of the hazards to which they are exposed; and (ii) those features are related with the geomorphological context of flooding – coastal, estuarine, and fluvial (flash or slow on-set)

flood.

A clustering analysis was run as part of an unsupervised learning algorithm, taking each building as the statistical individual, which is characterized by the on-site flood height and velocity, physical vulnerability and type of flooding.

The analysis produced relationships between flood hazard and the geomorphological context, which were related to the characteristics of the buildings, identifying the higher risk hotspots and informing decision-makers in territorial planning and civil protection emergency planning as to the priority situations related to climate change adaptation and mitigation measures.

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