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Micro-scale flood risk estimation in historic centres: a case study in Florence, Italy

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The route to flood risk assessment is much more than hydraulic modelling of inundation, that is hazard mapping. Flood risk is the product of flood hazard, vulnerability and exposure, all the three to be estimated with comparable level of accuracy. While hazard maps have already been implemented in many countries, quantitative damage and risk maps are still at a preliminary level. Currently one of the main challenges in flood damage estimation resides in the scarce availability of socio-economic data characterizing the monetary value of the exposed assets. When these public-open data are available, the variability of their level of detail drives the need of merging different sources and of selecting an appropriate scale of analysis. In this work a parsimonious quasi-2D hydraulic model is adopted, having many advantages in terms of easy set-up. In order to represent the geometry of the study domain an high-resolution and up-to-date Digital Surface Model (DSM) is used. The accuracy in flood depth estimation is evaluated by comparison with marble-plate records of a historic flood in the city of Florence (Italy). The accuracy is characterized in the downtown most flooded area by a bias of a very few centimetres and a determination coefficient of 0.73. The average risk is found to be about 14 €m2•year, corresponding to about 8.3% of residents income. The spatial distribution of estimated risk highlights a complex interaction between the flood pattern and the buildings characteristics. Proceeding through the risk estimation steps, a new micro-scale potential damage assessment method is proposed. This method is based on the georeferenced census system considered as optimal compromise between spatial detail and open availability of socio-economic data. The census sections system consist of geographically contiguous polygons that usually coincide with building blocks in dense urban areas. The results of flood risk assessment at the census section scale resolve most of the risk spatial variability and they can be easily aggregated to whatever upper scale is needed. Damage is calculated through stage-damage curves, starting from census data on building type and destination, for the main categories in the study area: structures, household contents and commercial contents. This method is tested in the area of S. Croce district in Florence, one of the most seriously affected in the famous 1966 flood. As a final example application, the estimated risk values have been used to compare different retrofitting measures.