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Anthropogenic impact on flood-risk: a large-scale assessment for planning controlled inundation strategies along the River Po

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The European Flood Directive (2007/60/EC) has fostered the development of innovative and sustainable approaches and methodologies for flood-risk mitigation and management. Furthermore, concerning flood-risk mitigation, the increasing awareness of how the anthropogenic pressures (e.g. demographic and land-use dynamics, uncontrolled urban and industrial expansion on flood-prone area) could strongly increase potential flood damages and losses has triggered a paradigm shift from "defending the territory against flooding" (e.g. by means of levee system strengthening and heightening) to "living with floods" (e.g. promoting compatible land-uses or adopting controlled flooding strategies of areas located outside the main embankments). The assessment of how socio-economic dynamics may influence flood-risk represents a fundamental skill that should be considered for planning a sustainable industrial and urban development of flood-prone areas, reducing their vulnerability and therefore minimizing socio-economic and ecological losses due to large flood events. These aspects, which are of fundamental importance for Institutions and public bodies in charge of Flood Directive requirements, need to be considered through a holistic approach at river basin scale. This study focuses on the evaluation of large-scale flood-risk mitigation strategies for the middle-lower reach of River Po (∼350km), the longest Italian river and the largest in terms of streamflow. Due to the social and economical importance of the Po River floodplain (almost 40% of the total national gross product results from this area), our study aims at investigating the potential of combining simplified vulnerability indices with a quasi-2D model for the definition of sustainable and robust flood-risk mitigation strategies. Referring to past (1954) and recent (2006) land-use data sets (e.g. CORINE) we propose simplified vulnerability indices for assessing potential flood-risk of industrial and urbanized flood prone areas taking into account altimetry and population density, and we analyze the modification of flood-risk occurred during last decades due to the demographic dynamics of the River Po floodplains. Flood hazard associated to a high magnitude event (i.e. return period of about 500 year) was estimated by means of a quasi-2D hydraulic model set up for the middle-lower portion of the Po River and for its major tributaries. The results of the study highlight how coupling a large-scale numerical model with the proposed flood-vulnerability indices could be a useful tool for decision-makers when they are called to define sustainable spatial development plans for the study area, or when they need to identify priorities in the organization of civil protection actions during a major flood event that could include the necessity of controlled flooding of flood-prone areas located outside the main embankment system.