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Hydraulic modelling for flood mapping and prevention: the case study of Cerfone River

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The research focuses on the hydraulic risk evaluation and danger estimation for different extreme flood events, in order to correctly implement mitigation measures in an anthropized basin. The Cerfone River (Tuscany, Italy), due to the several floods that have affected the neighbouring villages in recent years, is selected as case of study.
A finite volume numerical model that solves the shallow water equations all over the computational domain, was used to simulate the unsteady evolution of the maximum extent of flooded areas for different scenarios.
The one - dimensional approach (still widespread in engineering projects) can be inaccurate in complex flows, which are often two or three dimensional and sometimes does not manage to capture the flood spatial extents in terms of flow depth and velocity.
The use of a two-dimensional numerical model seems to be the suitable instrument in terms of computational efficiency and adequacy of results. In fact it overcomes the limits of a one-dimensional modeling in terms of prediction of hydraulic variables with a less computational effort respect to a full 3d model.
An accurate modeling of the river basin leads to the evaluation of the present hydraulic risk. Structural and non-structural measures are then studied, simulated and compared in order to define the optimal risk reduction plan for the area of study.
At this aim, different flooding scenarios were simulated through the 2D mathematical model: i) existing state of the river and floodplain areas; ii) design of a levee to protect the most vulnerable populated areas against the flooding risk; iii) use of off - stream detention basins that strongly amplify the lamination capacity of floodplains.
All these scenarios were simulated for different return periods: 50, 100, 200 and 500 years.
The inputs of the hydraulic models are obtained in accordance with the legislative requirement of Tuscany Region; in particular discharge hydrographs are evaluate through the ALTo (ALluvioni Toscana, Tuscany Region) procedure, a lumped model for the rain-runoff estimation.
The critical analysis and the comparison of the different project scenarios allow the definition of the reduction risk plan. The optimal choice will combine the need of danger reduction and that of the less economic effort to be done.