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Quick mapping of flood-prone areas in plain terrain using GIS analysis: applications for flood management plans over large areas

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Flood management plans, as required under the provisions of the "Flood Directive" 2007/60/EC, ground on the mapping of flood-prone areas.
When dealing with plain terrains, inundation modeling using bi-dimensional models may entail considerable efforts both in terms of data collection and processing, and of hydraulic computation. The resolution of numerical models may be limited if working on large areas, or conversely a model can tackle only relatively limited areas with a high resolution. On the other hand, a dynamic simulation of overland floods may be necessary for certain applications, but may be beyond the practical requirements of a flood management plan, for which it may be sufficient to identify the general characteristics of flow that drive potential risks, such as the type of flooding (slow or with significant dynamic component) and an indication of depth and velocity of flow.
In this contribution we present criteria for the classification of flooding type and for the mapping of first-approximation depth and velocity fields in case of floods, and we illustrate a few applications of simple GIS analyses entailing the use of hydrologic functions and mathematical morphology, that can be implemented in most GIS packages and can be used for quick mapping of flood hazards on plain terrain. In this way, no dynamic model implementation is required and computing time is irrelevant even at high resolution as allowed e.g. by LiDAR terrain models.
These applications refer to contexts in Italy including the Emilia Romagna regional basins flood management plan, the Province of Ravenna civil protection plan, hydraulic hazards on Northern Adriatic coastal areas and the assessment of hazards for a windfarm to be located in a flood-prone area in Puglia, Southern Italy.
We discuss how the approach can be generally applied in Europe with relatively limited and/or uncertain information, within the framework of the Floods Directive in support of flood hazards for subsequent planning and management of response.