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Surface water storage in alluvial and urbanized plains: the effectiveness of high resolution topography

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The correct representation of the draining system is crucial for the analysis of the hydrological processes and watershed management planning. While this topic has been deeply discussed in the last two decades for steep mountain landscapes, where the topographic information has been considered at different resolution scales, the pre-urban landscapes of alluvial plains actually represent the next challenge when using high resolution topography derived by airborne laser scanner (LiDAR). The utility of LiDAR derived Digital Terrain Models (DTMs) has been demonstrated for hydrological applications through several recent researches. Their capability to correctly represent surface depend partly on the surface being modeled and on the resolution of the provided input data. The accuracy with which a DTM is able to detect and correctly represent the hydrological asset of a catchment is determined by the strength of the landscape gradient (i.e. flatness and/or slope changes). Low-relief areas, such great alluvial plains, are so more challenging even when high-resolution DTMs are available. Modelling in detail the urbanized flood plain landscape represents really a strategic tool for flood risk management and surface water storage quantification in minor channels. In general, a very high percentage of such areas are drained by some form of artificial network in addition to the natural streams and channels. This drainage takes many different forms, dependent partly on the nature of the problem that it is trying to alleviate, and partly on the traditional agricultural practices that have been used in the past. The drainage may be aimed either at improving surface water conditions by removing ponded water from the surface, or at improving groundwater conditions by lowering the level of a high water table. In any case its role is crucial as it provides the storage that governs the hydraulic conditions during the high rainfall events. Because of the difficulties on quantifying the network on plain land directly from coarse DTMs, flow direction matrices that are derived from high resolution DTMs are critical. Unluckily the wideness of most of the ditches is about of the same dimension, or lower, of the LiDAR based DTM resolution. This prevents a simple DTM based surface analysis as the topography of many channel reaches is not fully recognizable. In this preliminary research we proposed a morphometric and semi-automatic methodology for mapping the artificial and natural networks in two tipical alluvial plains areas in the Padana plain. Based on the accurate field surveys by DGPS, and on the real water storage data collected by hydraulic monitoring stations, we tested our approach. The results underline the capability of high resolution topography in such analysis, opening at the same time a new challenge for modelling the hydrological processes in urbanized areas.