Geophysical Research Abstracts
Vol. 12, EGU2010-4553, 2010
EGU General Assembly 2010

Integration of sewer system maps in topographically based sub-basin delineation in suburban areas

Sonja Jankowfsky (1), Flora Branger (1), Isabelle Braud (1), and Fabrice Rodriguez (2)

(1) Cemagref, UR HHLY, Lyon, France (sonja.jankowfsky@cemagref.fr / 0033478477875), (2) LCPC, Division Eau et Environnement, Bouguenais, France (fabrice.rodriguez@lcpc.fr / 0033240845998)

Due to the increase of urbanization, suburban areas experience a fast change in land use. The impact of such modifications on the watershed hydrological cycle must be quantified. To achieve this goal, distributed hydrological models offer the possibility to take into account land use change, and more particularly to consider urbanized areas and anthropogenic features such as roads or ditches and their impact on the hydrological cycle. A detailed definition of the hydrographical drainage network and a corresponding delineation of sub-basins is therefore necessary as input to distributed models. Sub-basins in natural catchments are usually delineated using standard GIS based terrain analysis. The drainage network in urbanised watersheds is often modified, due to sewer systems, ditches, retention basins, etc.. Therefore, its delineation is not only determined by topography. The simple application of terrain analysis algorithms to delineate sub-basins in suburban areas can consequently lead to erroneous sub-basin borders.

This study presents an improved approach for sub-basin delineation in suburban areas. It applies to small catchments connected to a sewage plant, located outside the catchment boundary. The approach assumes that subsurface flow follows topography. The method requires a digital elevation model (DEM), maps of land use, cadastre, sewer system and the location of measurement stations and retention basins. Firstly, the topographic catchment border must be defined for the concerning flow measurement station. Standard GIS based algorithms, like the d8-flow direction algorithm (O'Callaghan and Mark, 1984) can be applied using a high resolution DEM. Secondly, the artificial catchment outlets have to be determined. Each catchment has one natural outlet - the measurement station on the river- but it can have several artificial outlets towards a sewage station. Once the outlets are determined, a first approximation of the "theoretical maximal contributing area" can be made. It encompasses the whole connected sewer system and the topographic catchment boundary. The area of interest is therefore defined. The next step is the determination of the extended drainage network, consisting of the natural river, ditches, combined and separated sewer systems and retention basins. This requires a detailed analysis of sewer system data, field work (mapping of ditches and inlets into the natural river). Contacts with local authorities are also required to keep up-to-date about recent changes. Pure wastewater and drinking water pipes are not integrated in the drainage network. In order to have a unique drainage network for the model, choices might have to be made in case of several coexisting drainage pipes. The urban sub-basins are then delineated with the help of a cadastral map (Rodriguez et al., 2003) or an aerial photography. Each cadastral unit is connected to the closest drainage pipe, following the principle of proximity and gravity. The assembly of all cadastral units connected to one network reach represents one urban sub-basin. The sub-basins in the rural part are calculated using the d8 flow direction and watershed delineation algorithm with "stream burning" (Hutchinson, 1989). One sub-basin is delineated for each reach of the extended drainage network. Some manual corrections of the calculated sub-basins are necessary. Finally, the urban and rural sub-basins are merged by subtraction of the urban area from the rural area and subsequent union of both maps.

This method was applied to the Chaudanne catchment, a sub-basin of the Yzeron catchment (ca. 4 km2) in the suburban region of Lyon city, France. The method leads to a 30 % extended catchment area, as compared to the topographic catchment area. For each river inlet the sub-basin area could be determined, as well as for each retention basin. This information can be directly used for the dimensioning of retention basins, pipe diameters, etc.