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An experimental peri-urban basin in North-western France

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Basins located in the suburbs, known as peri-urban basins, face a quick land-use change, increasing pollution and flood risks. Being neither urban nor rural basins, they have been left apart by hydrologists. Improving hydrological models taking into account both natural and anthropogenic surfaces and pathways is the objective of the French project AVuPUR. One of the two peri-urban basins chosen for this project is the Chézine basin, located in northwestern France, in the suburbs of Nantes. The Chézine basin is subject to an oceanic climate and has a quite flat topography. Whereas the upstream part of the catchment remains essentially rural, the urbanization is dense in the downstream part and under development in the medium part. The mean urbanization over the basin is about 18%. A first part of the project consists of collecting geographical and hydrological data, followed by a first hydrological data analysis. Then different spatial segmentation methods are tested based on a geomorphological analysis and ultimately hydrological models well adapted for these particular basins will be developed.

Nantes Metropole supplies geographical data as roads, buildings, land-use, sewer networks, Digital Elevation Model, etc. They also have monitored Chézine basin since 2001, with a water level recorder and a rain gauge. The outlet, at the water level recorder, defines a 29 km^2 basin with a 15km long river.
During summer 2008, additional recorders were installed, in the medium part of the basin, at the outlet of the rural subcatchment : a rain gauge and a flow meter. This will help to analyse the hydrological behaviour of the catchment, by characterizing the rainfall spatial variability over the basin and by pointing out the rural surface contribution.
In autumn 2008, a geophysical experimental study was carried out, using different geophysical methods: ground penetrating radar, DC-electrical resistivity tomography and EM31 electromagnetic profiling method. The aim of this study is to determine soil depths and first soil layers nature, by using the complementary between methods, in an attempt to contribute to hydrological processes description. First results show a quite good data quality but not a total consistency. Further analysis is in progress.
Finally, a land survey has been performed in order to make an inventory of the ditches over the rural subcatchment on the upper part of the basin. These ditches have been then introduced in the geographical database in order to analyze their contribution to the drainage network, and then to the hydrological response of the rural subcatchment.

Data analysis from 2001 to 2007 has pointed out a specific behavior of the basin: first, single peak rainy events sometimes produce one or two distinct peak discharge on the hydrograph; second, the lag-time of the basin is usually between 45 min and 1 hour but, sometimes, it can be greater than 6 hours. Geomorphological data analysis has shown that the localization of urbanization on the basin might be responsible for this dual-mode response. Nevertheless the initial moisture state of the basin plays a crucial part:
• when the initial state is dry, rural parts of the basin do not react, only urban zones contribute to runoff, leading to two peak discharges,
• on the contrary, when the initial state is wetter, rural areas can contribute to runoff and smooth the dual-mode response till a single mode one. In this case, the lag-time is increased.

For modelling part, different spatial segmentation methods are used. The first method is based on a constrained Triangular Irregular Networks (TIN) that integrates topographic data (contour lines) and anthropogenic

linear elements such as ditches, roads and hedgerows. The singularity of the approach lies in the definition of a new graph of cells called basins graph that expresses the relationships between linear constraints and topography. This basins graph is used to highlight the sequences of processes and the system networks that structure the organisation of the water pathway. The second method includes surface elementary units which are based on the administrative zoning (cadastral parcels) and land-use/geology combinations; these surface units are connected to linear elements constituting the drainage network (streams, rivers, ditches, roads, sewer networks). The third method simply uses a Digital Elevation Model made of regular squares. In order to compare these methods a geomorphologic analysis is performed. The comparison of geomorphologic functions deduced from each method shows the role of the considered anthropogenic objects on the hydrologic network representation.