The heterogeneity of the hydromorphological responses of a small peri-urban river to the urbanization of its basin

Lucile de Milleville, Frederic Gob, Laurent Lespez, and Evelyne Tales

1 Laboratoire de Géographie Physique, University Paris Est Creteil, Creteil, France (lucile.demilleville@lgp.cnrs.fr)
2 Laboratoire de Géographie Physique, University Pantheon-Sorbonne (Paris1), Paris, France (frederic.gob@univ-paris1.fr)
3 INRAE, Antony, France (evelyne.tales@inrae.fr)

For several millennia, large growing cities, like Paris in France, had transformed and ultimately altered the hydro-bio-morphological functioning of rivers that flow through them and drain their peri-urban neighborhoods. Consequently, those rivers, particularly the smaller ones, were completely disregarded, considered as part of the sewer system or feared because of the risk of flooding. Nowadays, the way these urban and peri-urban rivers are seen by the local populations and river managers are changing because of the European politics of ecological restoration of rivers coupled to the increasing demand of nature in the city. Within the Parisian metropolis territory more and more streams regain a place in the urban project, generally through projects of ecological restoration. Unfortunately, these restoration projects are often difficult to build and not always efficient because of the very strong urban constraints but also because of the lack of knowledge on the functioning of these small rivers. If the hydrological changes, the modifications in sedimentary dynamics, and in-bed geometry consequent to urbanization have been well described, the general heterogeneity of river responses makes it difficult to understand the whole picture of the river system and therefore to plan its restoration.

In this study of a small peri-urban river from the Parisian agglomeration, the river Morbras, we propose on one hand, to characterize the longitudinal geomorphological variations in the channel and identify river responses of urbanization and, on the other hand, to reconstruct the hydromorphological trajectory that led to this present situation and explain the heterogeneity.

The Morbras is a gravel bed river, 17.7km long, 6.4m wide, with a slope of 0.5%. Our results showed an average incision of 0.5m (locally over 1m), an average widening of nearly 1m (locally over 3m), and heterogeneous distribution of riffle-pool sequences. Systematic analysis of within-channel forms revealed high morphological diversity, the absence of a linear relationship between the rate of urbanization and incision/erosion, and the absence of longitudinal changes in response to urbanization. This may be explained by the history of the river and by its successive transformations that accompanied the multiphase transition of the catchment from fully rural to highly populated peri-urban. In particular direct intervention in the bed, initially for the creation of ponds, later for the installation of mills and more recently river management for flood mitigation or even old style river restoration.