



Stream-piracy impact on the long-term evolution of the Meuse basin. Physical approach "modeling with GOLEM"

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Landscape evolution results of antagonistic processes. In the Paris basin (France): tectonic uplift seems to be globally balanced by river incision. But the dynamic equilibrium of the relief can be disturbed by other processes and singularities may appear. A remarkable example is observed in the Meuse basin (NE of France), where the river is actually perched at more than +50m above the surrounding valleys: the Marne valley to the west and the Moselle valley to the east.

This special morphology is the result of several stream piracies (at the expense of the Meuse) which has interested numerous researchers since a long time (Davis 1895, Blache 1943, Lesson-Quinif 2001 & Le Roux Harmand 1997-2009...). The most important ones of these piracies are: 1) the well-known capture of the Haute-Moselle by a tributary of the Meurthe near Toul; 2) at the north-west, the capture of the river Aire by the Aisne. On-going evolution suggests that similar events can be expected in the long-term future. Where and when next streams piracies could occur, what consequences may be expected?

Our approach is to simulate the dynamic evolution of the landscape with an improved version of GOLEM (Geomorphic / Orogenic Landscape Evolution Model - LEM), software developed by Tucker & Slingerland in 1994 (<http://csdms.colorado.edu/wiki/Model:GOLEM>). The LEM characterizes erosion by incorporating diffusion and advection equations whose parameters must be fixed, according to local conditions. First simulations for next millions years with « detachment-limited » mode, let us locate several potential captures of the Meuse river by tributaries of the Moselle, therefore inducing a complete reorganization of the hydrographic network. The results of the localizations agree with local topography/geometry analysis. The first capture induces the propagation of a knickpoint and a significant lowering of the upstream part of the Meuse's basin. Downstream of the capture, the orientation of the abandoned valley "slowly" inverts and a new Meuse's tributary appears (like the Agron's river after the Aire's capture). The asymmetry of these processes shows the importance of the localization and the order of the piracies on post-capture landscape evolution. In these simulations, unlike piracy-order, timing depends widely on the physical parameters of the model: in first approximation, durations are proportional to the bedrock erodibility.

More complex simulations are in process, taking into account lithological differences of outcropping layers, Meuse deposition tendency...