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## Long-term trajectory of an embankment fluvial system – the Loire River (France)

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The new French regulation concerning the management of flood zones makes it possible to lower dikes that protect less than 30 inhabitants. Many dykes in rural areas fall into this category and can therefore be removed or lowered. In this context, we studied a long rural dyke (7 km) in the Loire valley (France). The dyke has created a “triple fluvial bed”, composed by a floodplain protected from frequent floods, a currently active bed and between the two parts, a floodplain occupied by a riparian forest - the active bed and the proximal floodplain being protected (Natura 2000). The objectives of this work are therefore i) to analyze the long-term trajectory of the embankment system in order to understand evaluate the potential effectiveness of the dyke removal; ii) the precise study of the alluvial forest aims to build a modelling of the future evolution. We developed a pluri-disciplinary approach combining history, earth science (geomorphology, sedimentology, geophysics and hydrology) and biology (study of the alluvial forest mainly by dendrology).

The historical study based on archival maps shows that the dike was built in several stages from the mid-18<sup>th</sup> century to the 1810s. The dyke has led to a fluvial metamorphosis marked by a strong reduction of the sinuosity and fluvial bed simplification. The river channel narrowed by two thirds. The alluvial vegetation progression not only reflects the fluvial form evolution, but also economic practices. On the one hand, pioneer vegetation growth was delayed by the agro-pastoral practices that ended at in the 1970’s. On the other hand, the dyke and the proximal floodplain were planted with hay and fruit trees, in order to protect the engineering work from erosion. Thus, different generations of fluvial forms are identified.

The precise study of the vegetation distribution allows to precisely determine the readjustment of the bed and the environmental drivers. The dendrochronologic analyses of the alluvial trees (hardwood and softwood forest) are good proxies to identify controlling factors at an annual time scale: hydrology (mainly frequency/duration of floods and of low water levels), climate and fluvial form evolution. The approach reveals a recent change (at the beginning of the 1990’s) that is mainly induced by the fluvial bed entrenchment and by the increasing duration of low water level. Finally, the study suggests that the dyke removal will not drastically modify the biogeomorphologic dynamics.