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Predicting the aquatic stage sustainability of a restored backwater channel combining in-situ and airborne remotely sensed bathymetric models.

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As other large river floodplain worldwide, the floodplain of the Rhône has been deeply altered by human activities and infrastructures over the last centuries both in term of structure and functioning. An ambitious restoration plan of selected by-passed reaches has been implemented since 1999, in order to improve their ecological conditions. One of the main action aimed to increase the aquatic areas in floodplain channels (i.e. secondary channels, backwaters, ...). In practice, fine and/or coarse alluvium were dredged, either locally or over the entire cut-off channel length. Sometimes the upstream or downstream alluvial plugs were also removed to reconnect the restored feature to the main channel. Such operation aims to restore forms and associated habitats of biotic communities, which are no more created or maintained by the river itself. In this context, assessing the sustainability of such restoration actions is a major issue.

In this study, we focus on 1 of the 24 floodplain channels which have been restored along the Rhône River since 1999, the Malourdie channel (Chautagne reach, France). A monitoring of the geomorphologic evolution of the channel has been conducted during a decade to assess the aquatic stage sustainability of this former fully isolated channel, which has been restored as a backwater in 2004. Two main types of measures were performed: (a) water depth and fine sediment thickness were surveyed with an auger every 10 m along the channel centerline in average every year and a half allowing to establish an exponential decay model of terrestrialization rates through time; (b) three airborne campaigns (2006, 2007, 2012) by Ultra Aerial Vehicle (UAV) provided images from which bathymetry were inferred in combination with observed field measures. Coupling field and airborne models allows us to simulate different states of terrestrialization at the scale of the whole restore feature (e.g. 2020/2030/2050).

Raw results indicate that terrestrialization is high, primarily driven by fine sediment accumulation and decrease exponentially through time (e.g. median rate of 12 cm.an-1 two years after restoration and of 6 cm.an-1 nine year after restoration). Predicted water depth from field measures are rather good (R^2= 0.85; RMSE = 10.7) as well as Airborne bathymetric models (R^2 values between 0.71 and 0.89 ; vertical error between 9 and 12 cm). Predictive models demonstrate that such restoration of forms can be a sustainable measure along the Rhône river. More widely, these results can help managers in the definition of adaptive measures or can be used to improve the design of restoration plan.