Numerical modelling contribution to sedimentary sedynamisation projects in a lowland gravel-bed river: the Ain River, France

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Introduction

Ain river characteristics :

mean annual discharge : 120 m³/s

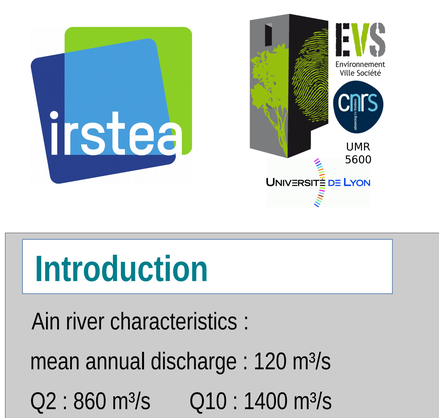
Q2 : 860 m³/s Q10 : 1400 m³/s

Sedimentary deficit ~ 15,000 m³/year

⇒ Excavation and reconnection of old channels
Injection of the mined sediments

Objectives :
Estimate the efficiency of these redynamisation scenarii as well as their associated risks thanks to numerical modelling.

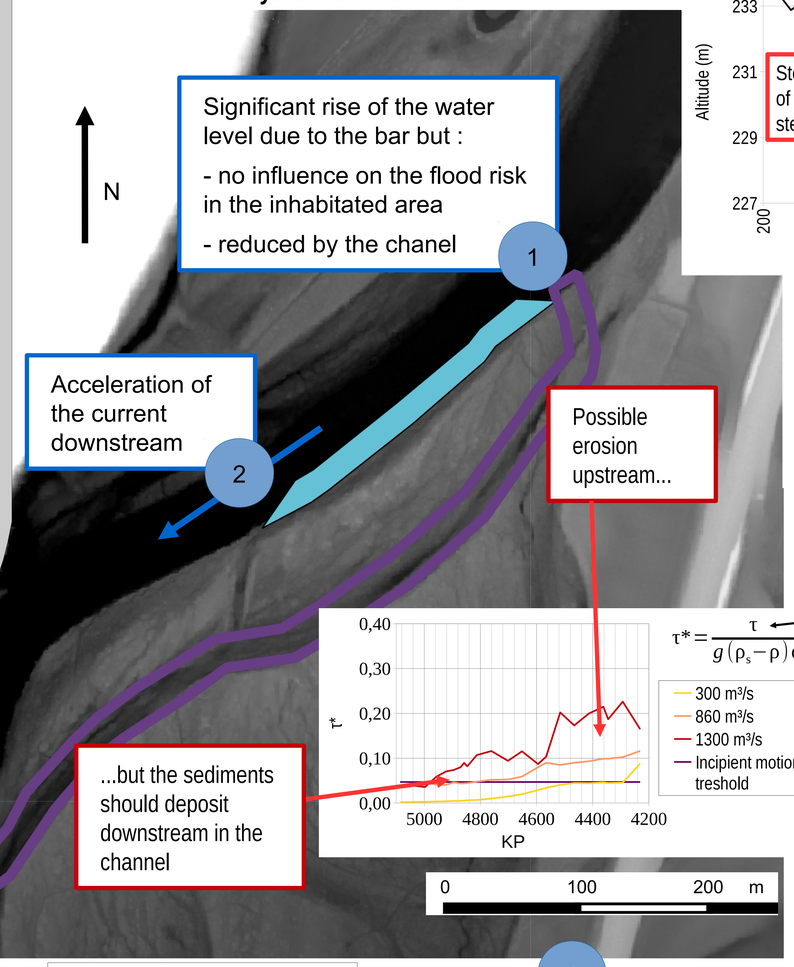
Numerical software developed by Irstea:
- 1D hydraulic: MAGE
- 1D hydraulic and sedimentary: RubarBE
- 2D hydraulic and sedimentary: Rubar20TS



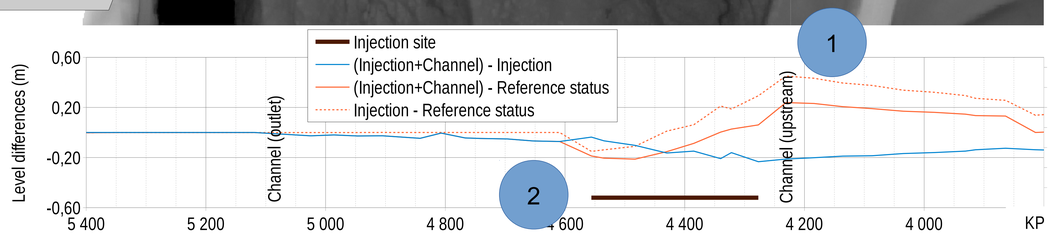
Characterise the reference status

Determine the connection level of the channel

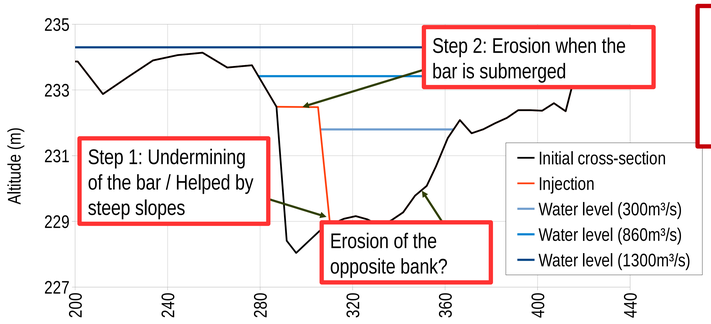
Determine the new hydraulic conditions



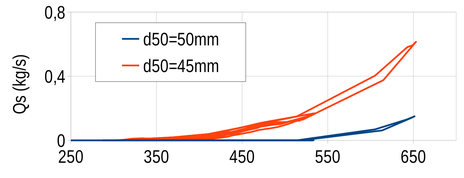
Output of the model



Estimate the critical discharge for incipient motion and describe the erosion processes



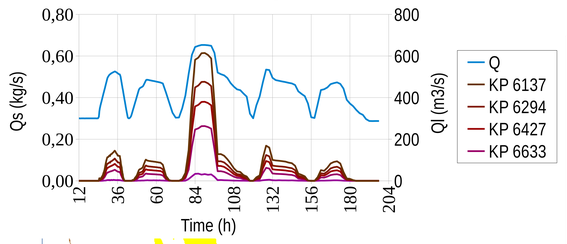
Critical discharge for incipient motion :
- sensitive to the grain size (d_{50})
- quite frequent (350 to 525 m³/s)



Determine the evolution of the river morphology

The grid that represents the injection area does not seem fine enough to describe correctly the gravel bar evolution

Evaluate the transport distances and solid discharge



Difficulty in discriminating the sediments of the bar from the others

Modelled transport distances (~ 4 to 5 km for 1 year) > Observed travel distances of PIT tags (800m) (Arnaud, 2014)

References

Arnaud, F., Piégay H., Michel K., Bultingaire L., Collery P., Drissi N., Tissot C.(2014). Caractérisation de la dynamique sédimentaire et des habitats aquatiques d'une rivière régulée: l'exemple de l'Ain dans sa haute et basse vallée, IS Rivers 2015.

Béraud, C. (2012). Modélisation numérique des impacts de recharges sédimentaires en rivière aménagée. Cas du Vieux-Rhin entre Kembs et Breisach. Thèse de doctorat. Université Claude Bernard – Lyon 1

Rollet A.J. (2007). Étude et gestion de la dynamique sédimentaire d'un tronçon fluvial à l'aval d'un barrage : le cas de la Basse Vallée de l'Ain. Thèse de doctorat Université Jean Moulin Lyon 3

Perspectives

Refine the grid in order to improve the representation of the sedimentary processes

Analyse the evolutions of the river morphology and evaluate the influence of the injections on the grain size distribution

Apply these results in a biological model (to evaluate the evolutions of the habitat quality for fish using water depth, current speed, and substratum composition)