Mechanisms of vegetation removal by floods on bars of a heavily managed gravel bed river: Isère River, France

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Context and questions

The morphology of river beds is maintained by their hydrological and sediment regimes. It is also highly impacted by vegetation, which has a stabilizing impact on channel morphology.

River training (dam, dykes) alters sediment supply and hydrological regime

Channel morphology becomes more stable

encroachment Vegetation common in managed rivers, and presents problems of:

- increased flood risks
- biodiversity loss
- costs of mechanical clearing

In this context, we are investigating whether artificial floods can be used to limit vegetation establishment on managed rivers.

Research questions:

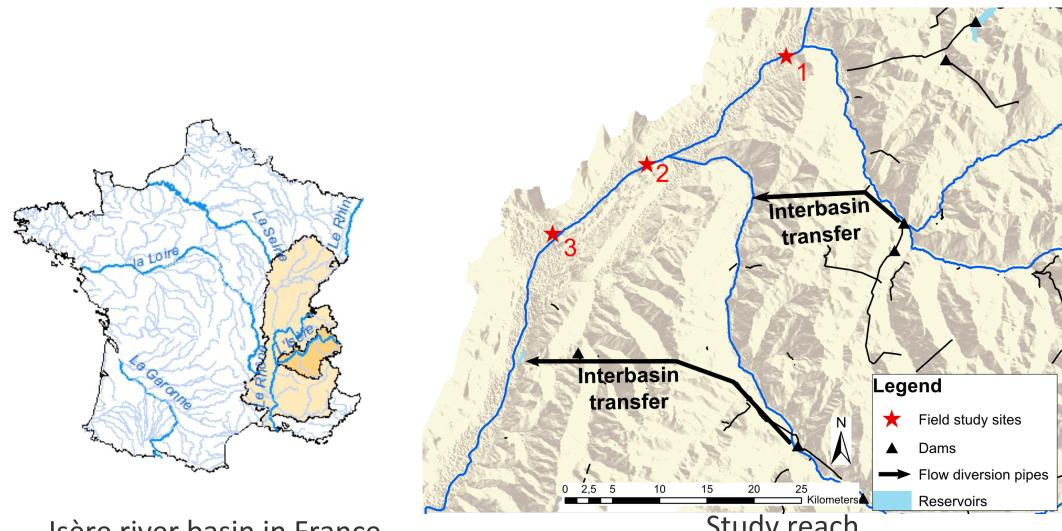
Vegetation

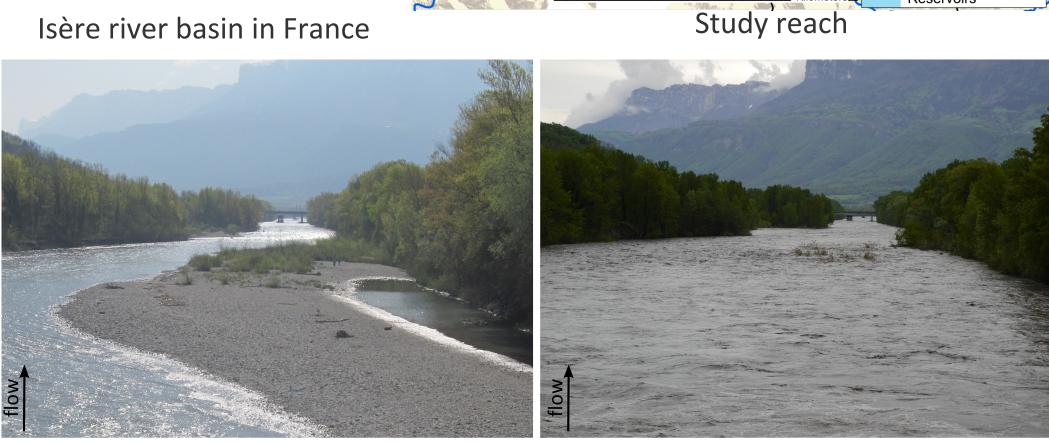
establishes on bars

- → What are the mechanisms of vegetation removal from river bars by floods?
- → Can we relate these mechanisms to specific conditions of bed mobility?
- → Which floods are able to remove vegetation from bars on the Isere River?

Study Site: Isere River, French Alps

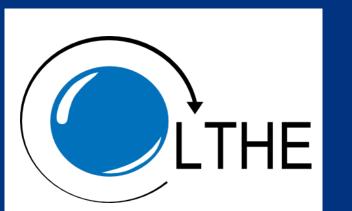
The Isere River is a formerly braided Alpine gravel bed river. It has been heavily impacted by dyking, sediment extractions, and hydroelectricity. Three field sites are being monitored.





View of the Isère River at low and high flow (site 3)

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Vegetation cover

Fig. 1, Fig 2.b, d, f, Fig. 3

sparse grasses

invasive sp.

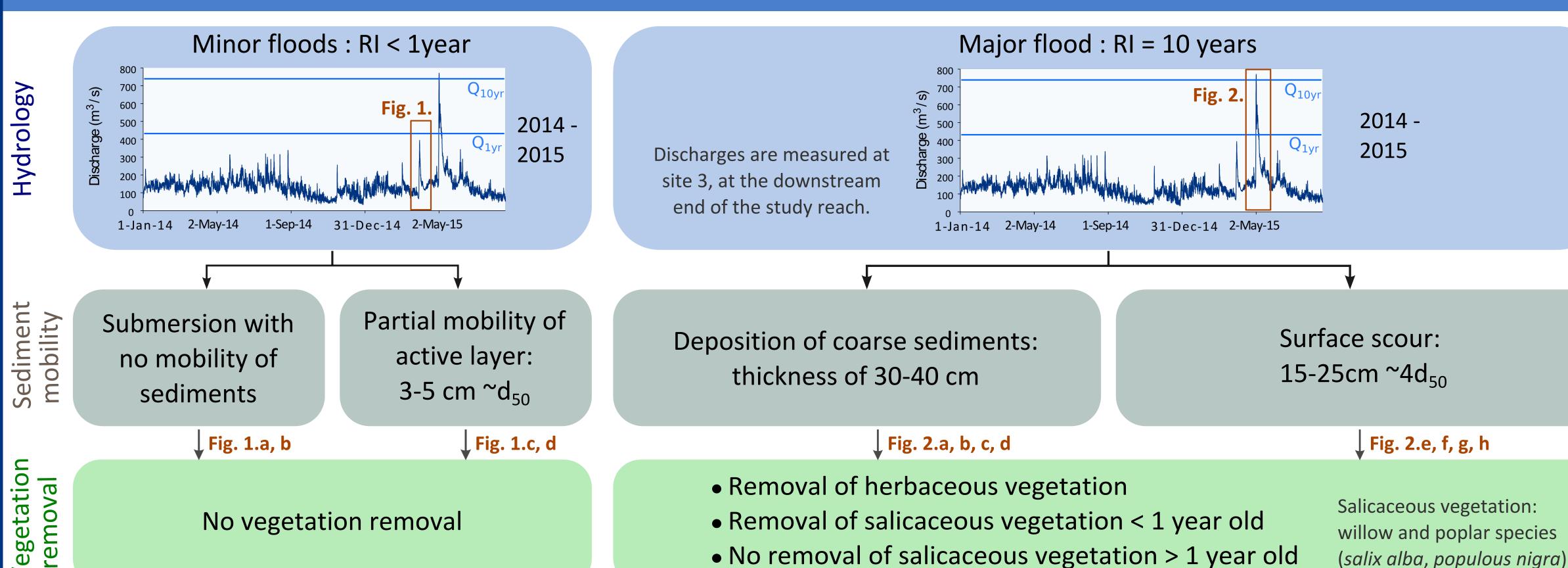
dense herbaceous veg.

salicaceous sp. <1 year

salicaceous sp. >1 year

vegetation removal during 10 year flood

Observed impacts of floods on bed mobility and vegetation



Field monitoring at bar scale. Evolution of 25m² plots studied using repeat photographs.

herbaceous vegetation but not salicaceous vegetation

Fig 2.b, d, f

Vegetation removal

total removal

★ partial removal

no removal

no vegetation

Fig. 2. Bar mobility observed through painted plots and net topographic change (2.a, c, e) following Fig. 1. Mobility of painted plots and no vegetation removal during minor flood (03/2015, RI < 1yr) : mobility of painted plots in unvegetated zones site 2: very little mobility of painted plots Before flood, March 12, 2015 After flood, April 14, 2015 25 m² plot of site 3: no removal of herbaceous 25m² plot of site 3: scour of ~15 cm removed

vegetation despite important mobility of surface layer

Fig 2.a, c, e

Topographic change

net erosion > 15 cm

new bar surface

net depositon > 15 cm

surface loss

Plot

Mobility of painted plots

disapearance/total mobility

Legend

Fig. 1, Fig 2.a, c, e

partial mobility

no mobilty

no data

a major flood (05/2015, RI = 10 years), and induced vegetation removal (2.b, d, f) site 1: important deposition upstream (> 40 cm) led to removal of herbaceous vegetation site 2: erosion and deposition (40-60cm) removed herbaceous and young salicaceous vegetation < 1 year old site 3: surface scour of 15-25 cm removed herbaceous vegetation and young salicaceous vegetation < 1 year old Before flood, May 12, 2015 Before flood, April 14, 2015 After flood, July 10, 2015 After flood, Mai 12, 2015

Minor and major floods: RI = 10 years 2006 Morphological reconfiguration of Bank erosion bars **↓** Fig. 3.a Fig. 3.b Removal of all types of vegetation

Aerial photo analysis

Fig. 3. Vegetation removal through bank erosion (3.a) and bar reconfiguration (3.b)



10% of vegetation surface seen on aerial photos in the bed in 2006 was no longer present in 2009, on a 16 km reach. Bank erosion was responsible for 60% of removal, and bar reconfiguration for 38%. 2% were due to surface processes, i.e. scour or deposition.

Take home

25 m² plot of site 3: scour of 25 cm removed

herbaceous and young salicaceous vegetation

- ✓ Partial mobility of the active layer is not sufficient to remove vegetation from bars.
- ✓ Surface Scour (15-25 cm) and deposition (> 40 cm) are able to remove pioneer vegetation.
- ✓ Mature vegetation is most efficiently removed by bank erosion and complex bar reconfiguration.
- ✓ On the Isère river, only major flood events induce enough bed mobility to remove vegetation from river bars.