



USE OF BASEMENT 2D AS A FUNDAMENTAL TOOL IN DIFFERENT STAGES OF HYDROPEAKING MITIGATION: THE SARINE RIVER CASE STUDY

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INDEX

1. CONTEXT

2. MODELING HABITABILITY

3. INDICATORS ASSESSMENT

4. BEDLOAD MODELLING

5. CONCLUSIONS



CONTEXT

LEaux 2011 :

Measures to mitigate the negative impacts of dam exploitation :

- bedload regime
- fish migration
- hydropeaking



Lessoc Dam in the Sarine river



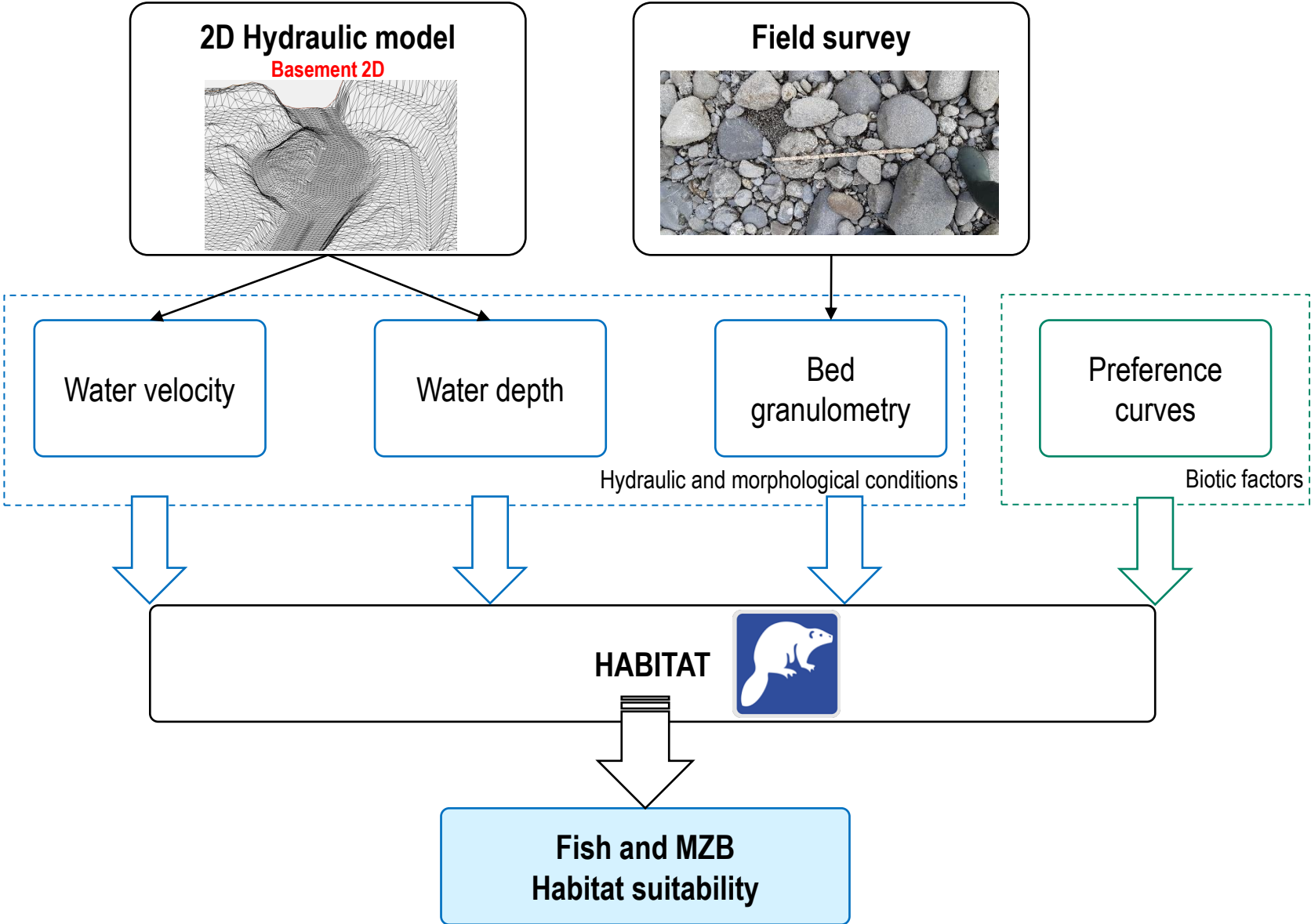
MODELING HABITABILITY

For hydropeaking mitigation, the current state and its deviation from a natural one are characterized by FOEN indicators.

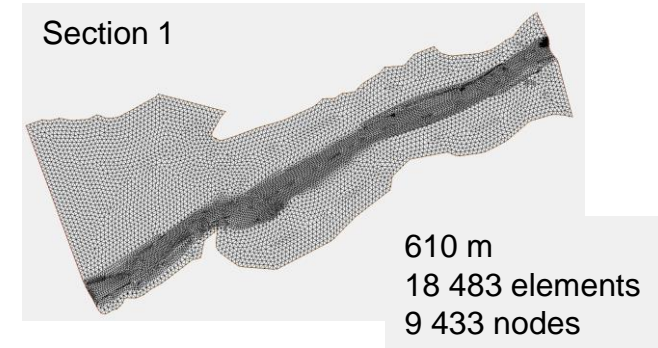
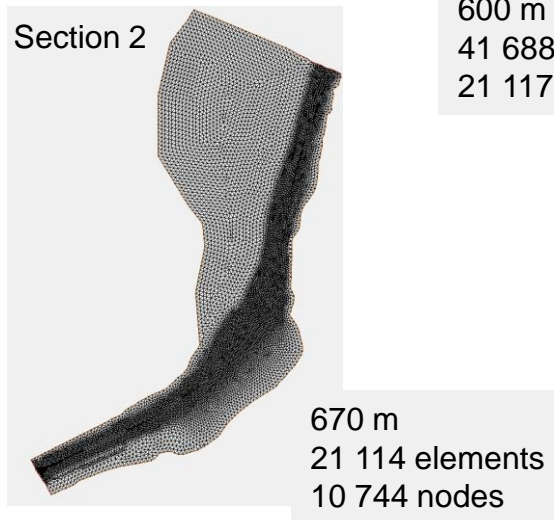
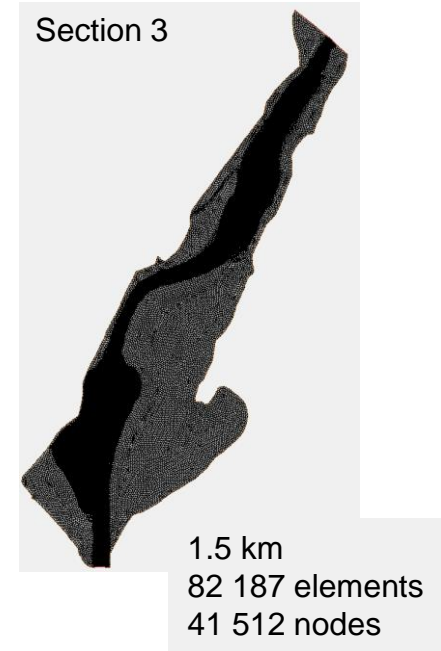
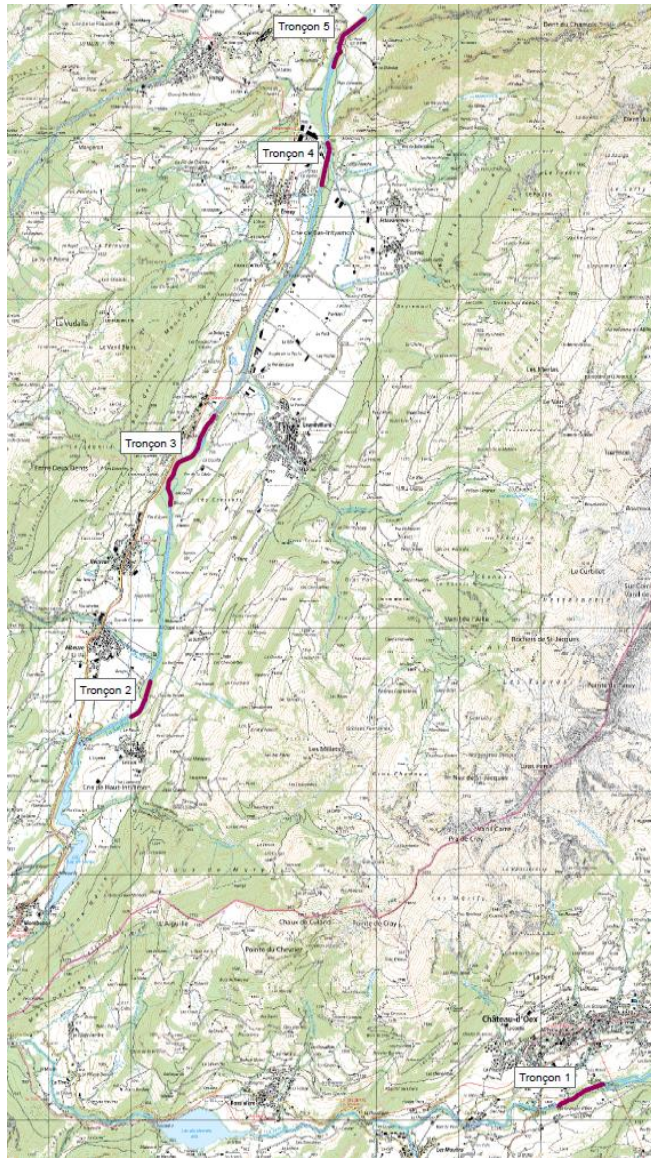
Four of them concern habitability :

- **P2* – Fish Stranding** { Proportion of dry/wet surfaces
Downward rate (cm/min)
 - **P3* – Fish Spawning**
 - **P6 – Fish Habitability**
 - **B5 – Macrozoobenthic Habitability**
- Appropriate depth, velocity and granulometry for each target species

MODELING HABITABILITY



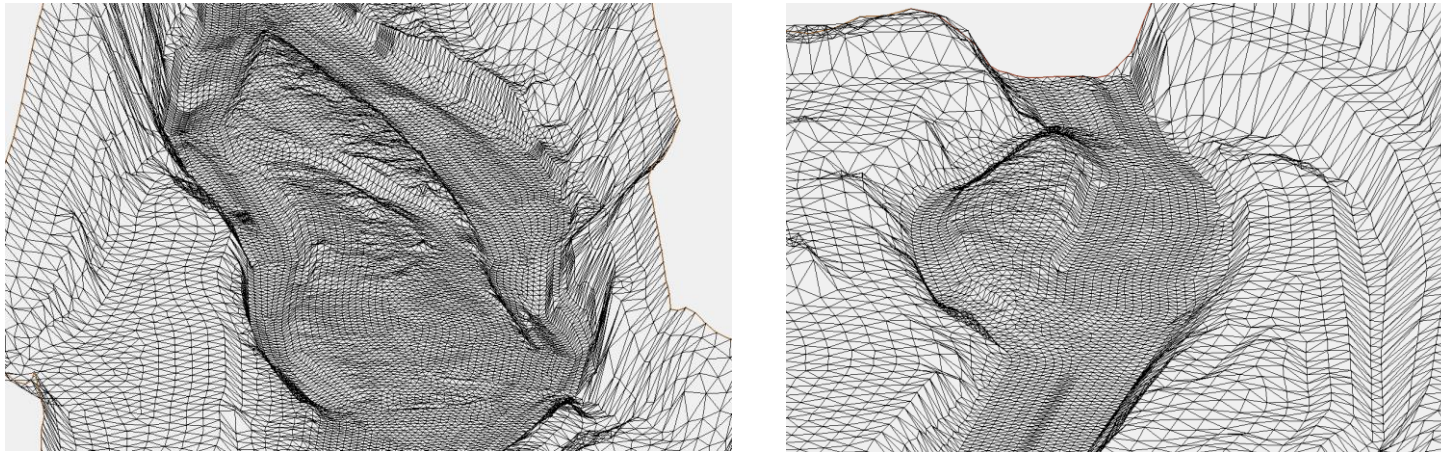
MODELING HABITABILITY



MODELING HABITABILITY

Basement 2.8

Detailed modelling of the gravel beds



Headloss according to the Chezy formula

Calibration according to depth and grain measurements

Hydraulic modelling only : 40 to 55 different stable flows per section

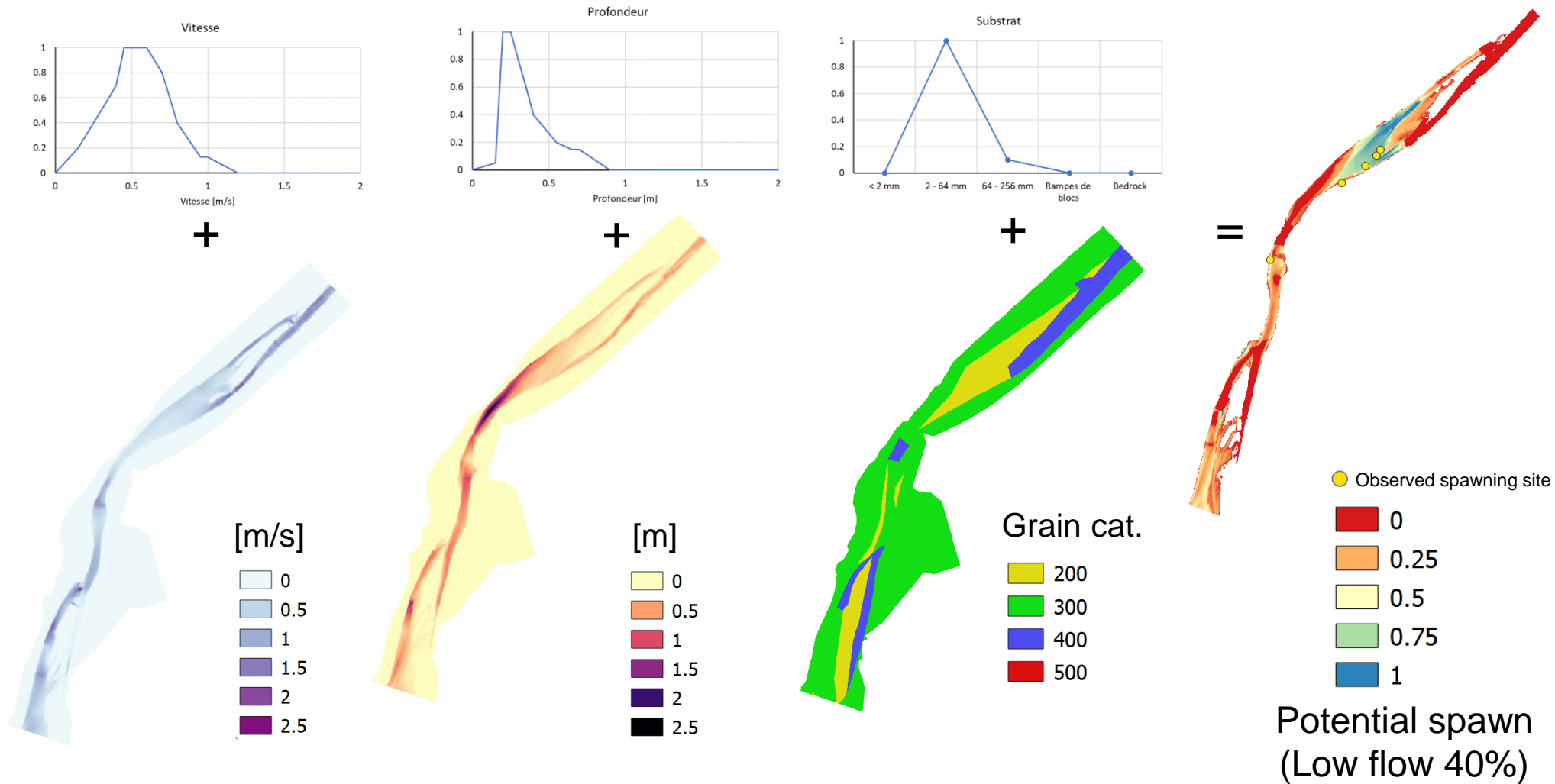
INDICATORS ASSESSMENT

- **Modelling of 5 sections (~500 m to 1000 m)**
- **3 indicative species for fishes : Trout, Grayling and Nase**
 - 4 development stages : spawning, fry, juvenile and adult
- **3 indicatives species for macrozoobenthos**
- **2 different flow rate for the current state**
 - Low flow
 - Peak flow
- **1 flow rate for the reference state**

OVER 200 MAPS OF HABITAT SUITABILITY TO PRODUCE !

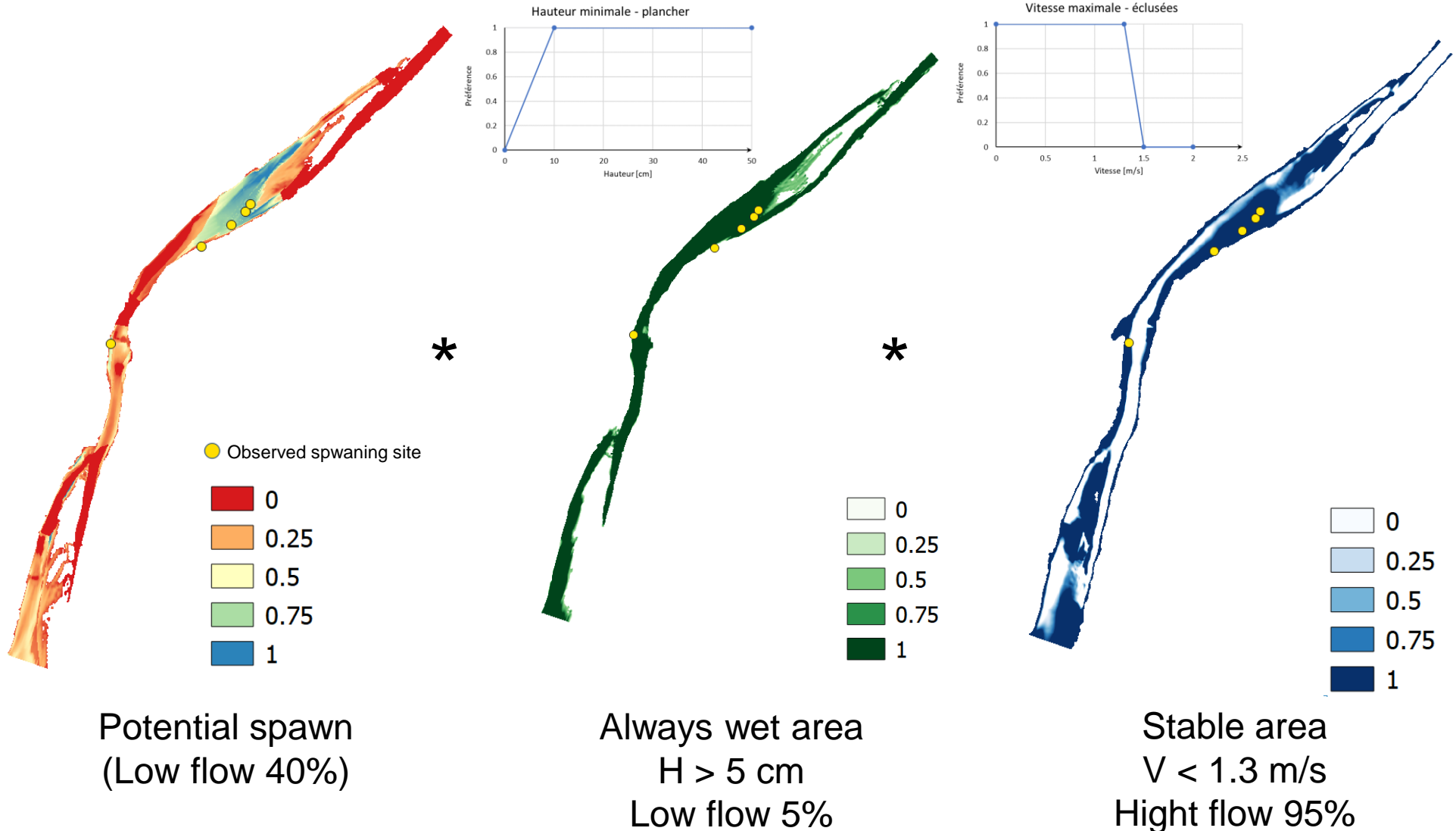
INDICATORS ASSESSMENT

Example of trout spawning (P3*) in T5



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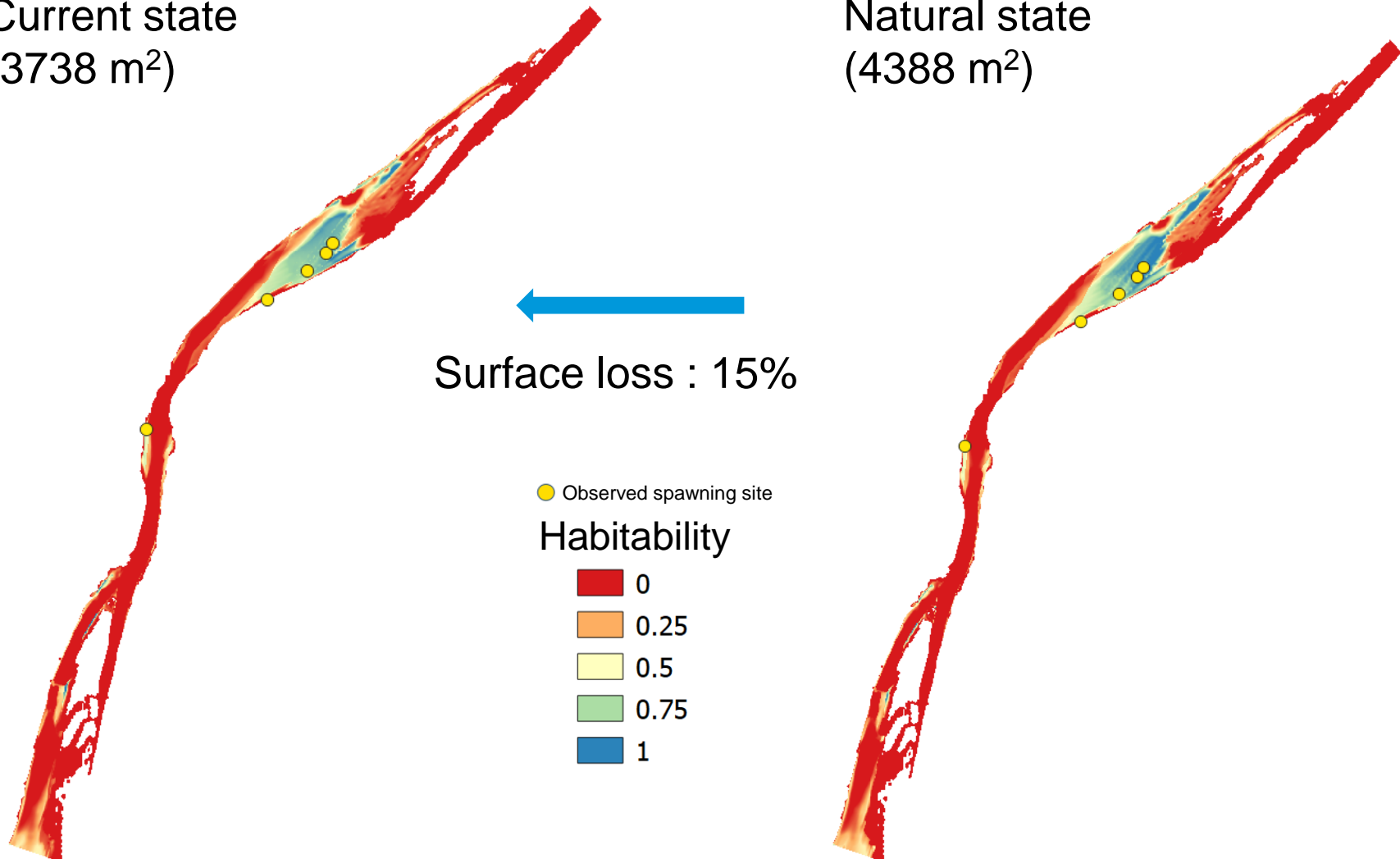


INDICATORS ASSESSMENT

Example of trout spawning (P3*) in T5

Current state
(3738 m²)

Natural state
(4388 m²)



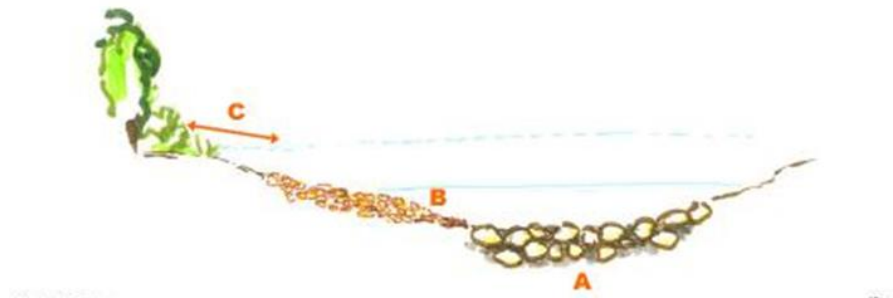
BEDLOAD MODELLING

Bedload regime restoration aims to :

A Restore natural morphology (long term process)

B Restore grain coverage quality (and **habitability**) : short term process

C Restore connectivity to alluvial areas: slope change (long term process)



Objectif of bedload modelling of the mitigation measures :

Evaluate incidence on bed grain coverage → basis for estimation of joint efficiency

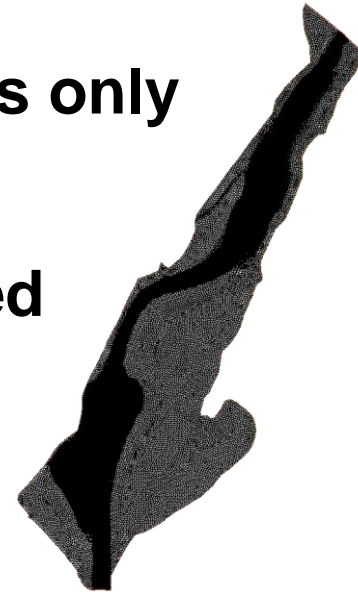
BEDLOAD MODELLING

Section 3 was further used to predict the result of bedload regime restoration measures → sediment replenishment of 1500 to 2000 m³/year

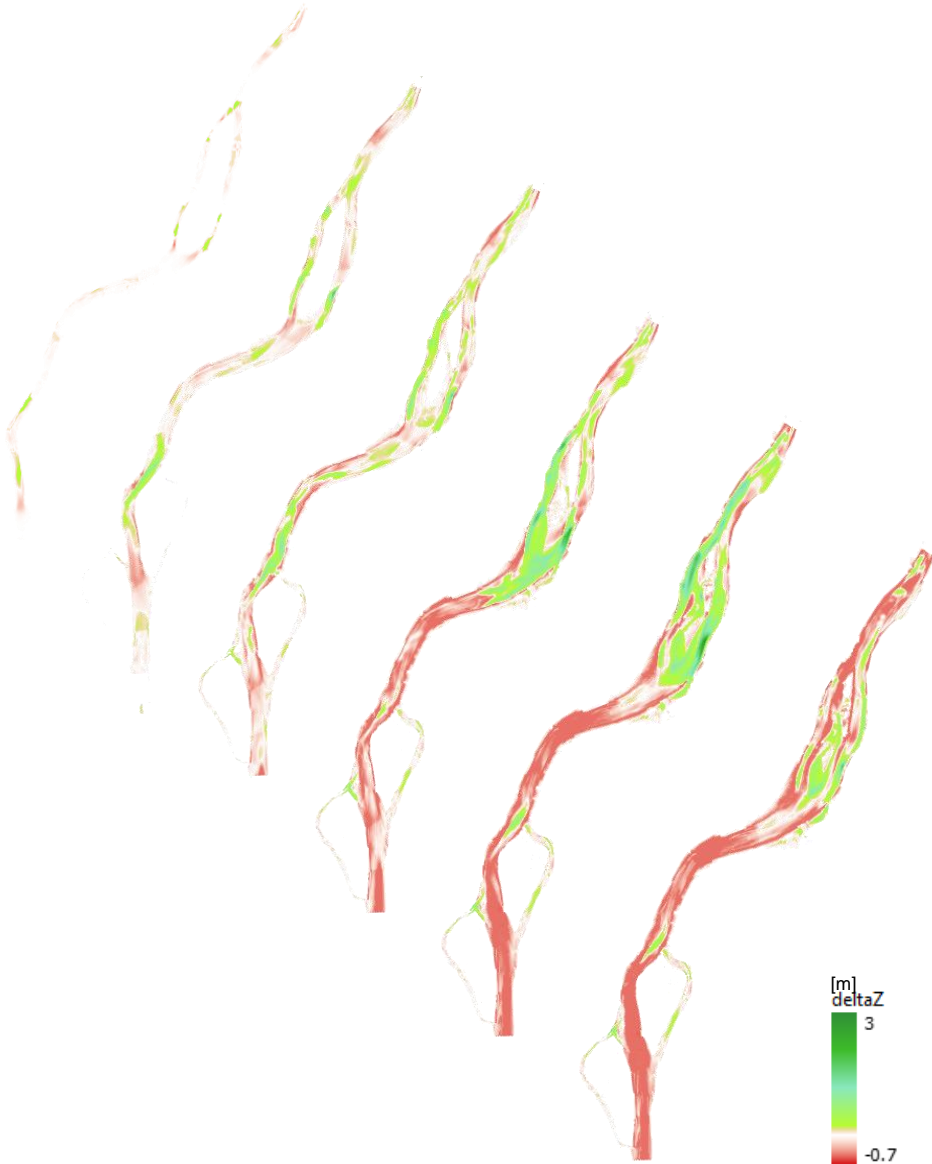
Goal : future grain class coverage of the riverbed

Details of the modelling :

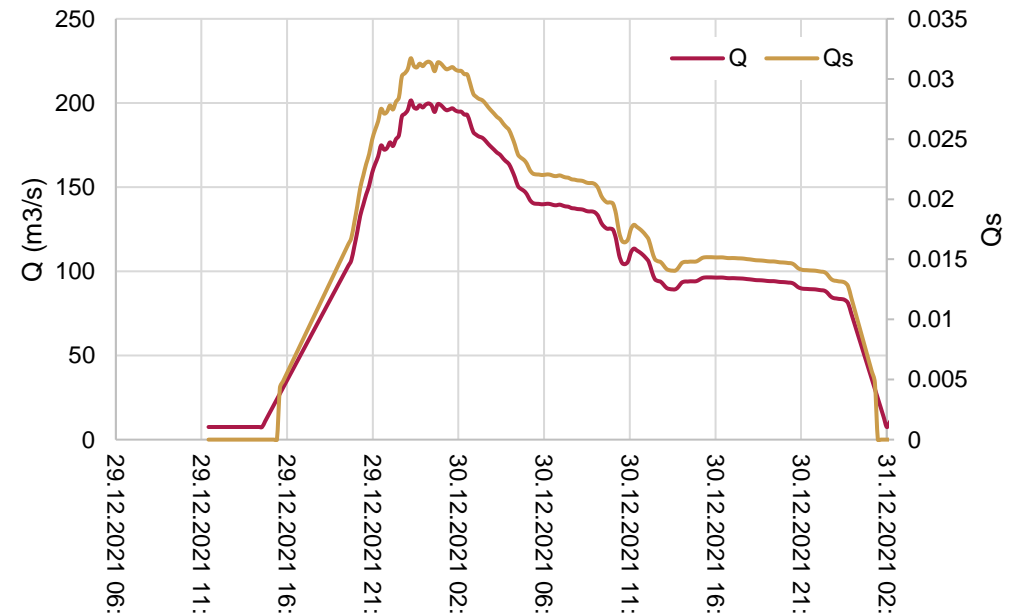
- Use of the same model assembled for hydraulics only
- Add of upstream sediment inflow
- 9 grain classes for the description of the riverbed coverage and the inflow
- Wu bedload formula



BEDLOAD MODELLING

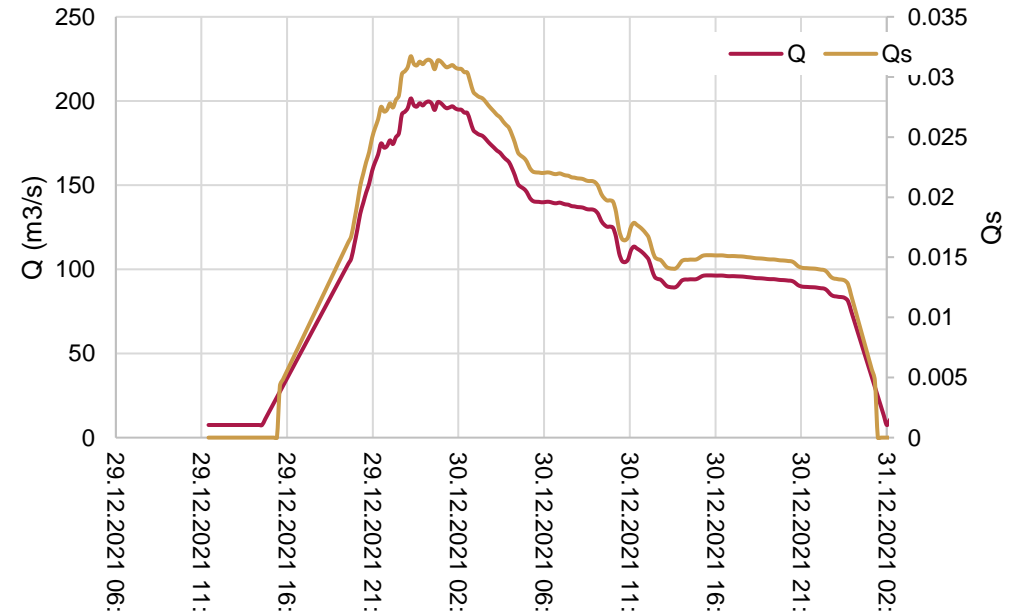


- Tendency to erode
- No possible calibration



BEDLOAD MODELLING

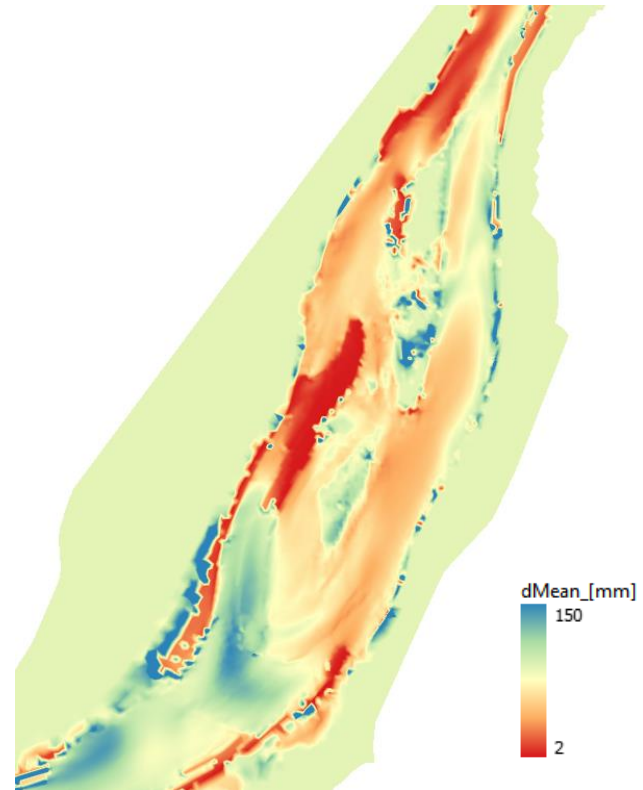
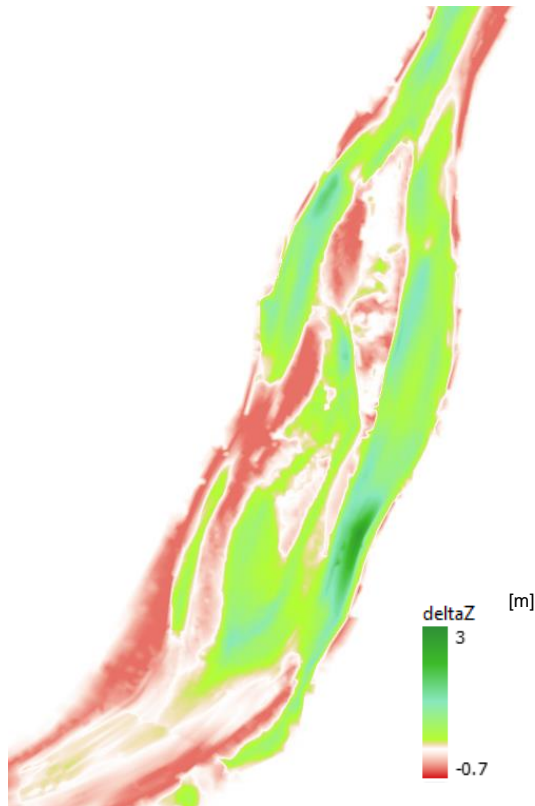
- Tendency to erode
- No possible calibration



BEDLOAD MODELLING

The objectif is to have an estimate on the incidence on bed substrat

Focus on the downstream



CONCLUSIONS

This prediction of future grain classes and riverbed movement can be used to re-access the habitability considering a **fully restored state** : hydropeaking + bedload mesures.

We expect to find **synergy** : the improvement of the habitability will be superior if the bedload regime is also restored

As consulting engineers, we often don't have data to calibrate bedload transport and we cannot perform exhaustive sensitivity analysis.



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