Incipient motion for bimodal mixture of gravel and silt

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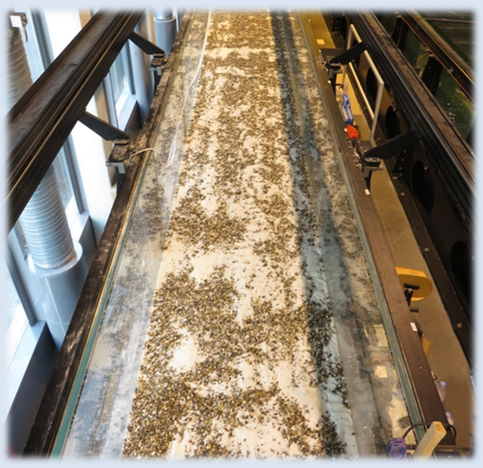
1. Context

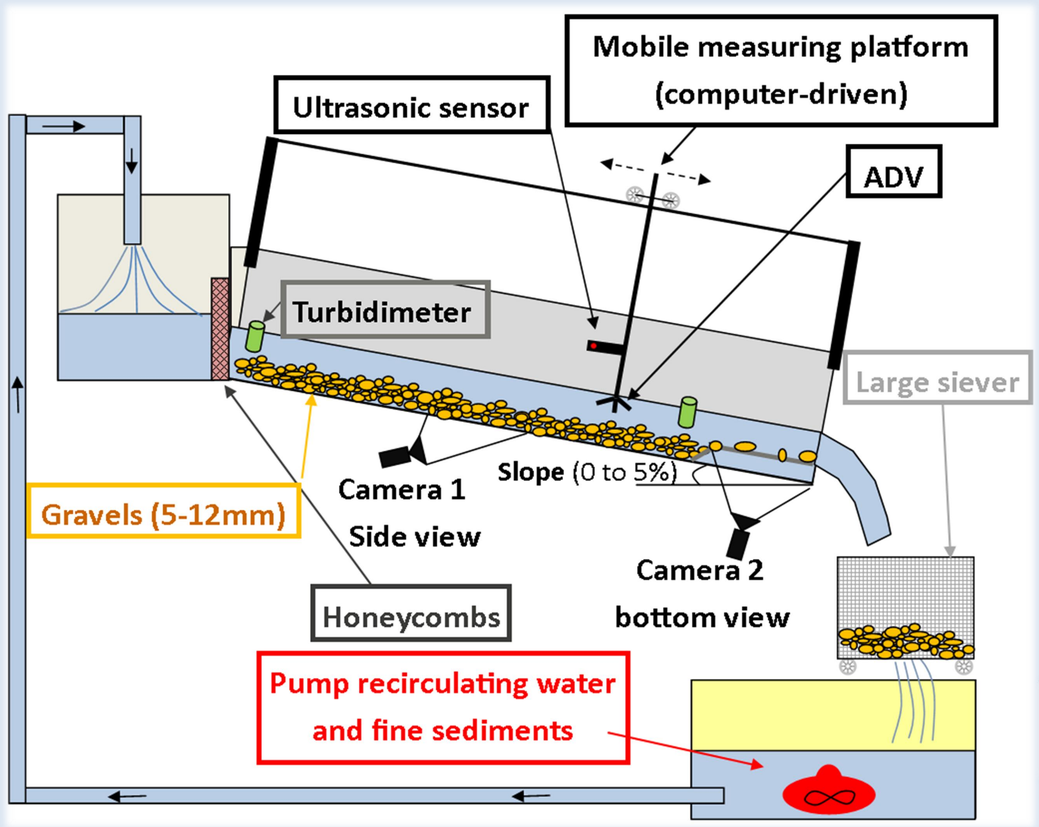
- Water and sediment management:
  - **socio-economic** issues
  - **ecological** issues
- Sediment transport close to the inception of motion
  - **mechanisms** not completely understood
  - **large uncertainties** in the estimation of the critical bed shear stress and sediment transport close to the inception of movement (Buffington and Montgomery, 1997; Camenen and Larson, 2005; Recking, 2013)
  - few studies on bed made of **bimodal** or **multimodal** mixture of sediments, especially for a **gravel/silt** mixture often observed in alpine rivers (Wilcock and Southard, 1988; Patel and al., 2013)
- Complex interactions between fine and coarser sediments:
  - **lubrication** effects? **consolidation** effects?
  - Impact on the **roughness height**

3. Objectives

- Analyzing & understanding processes controlling the **incipient motion of a gravel and silt mixture**
- Evaluating potential **interactions**
- Collect a complete **data set**

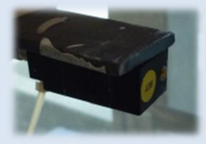
2. Experimental set-up





Measurements

1. Water depth + Bed slope



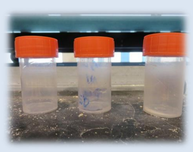
Ultrasonic sensors

2. Velocity

ADV

3. Fine concentration

Turbidimeter



Sampling

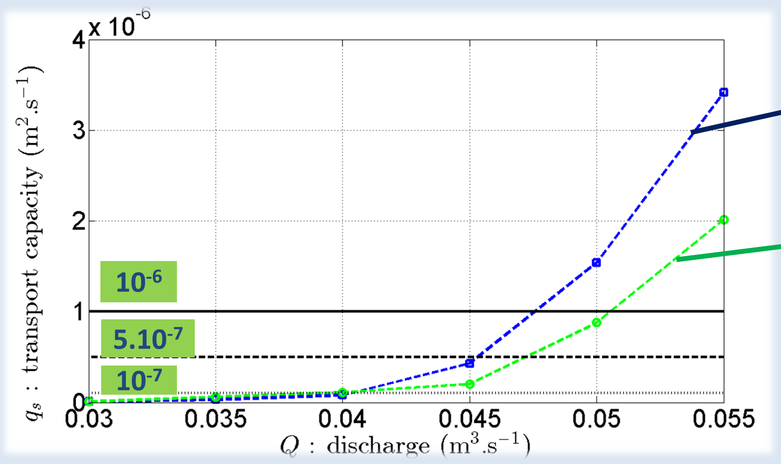
4. Bed load samples

Large sieve & Image processing

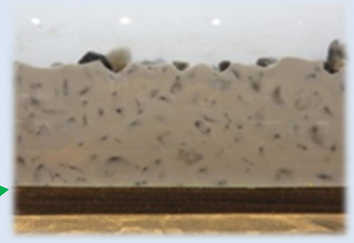
5. Bed-surface analysis

(grain size distribution, roughness, topography)

4. Results

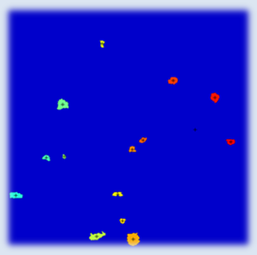


Clean bed
Gravel only

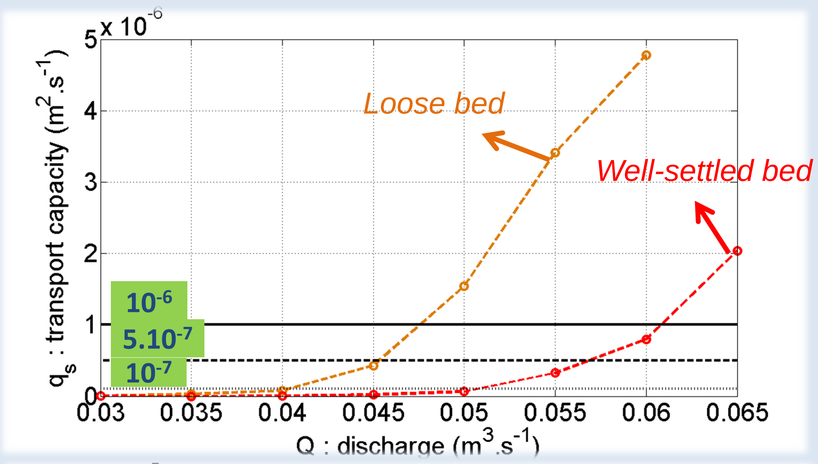


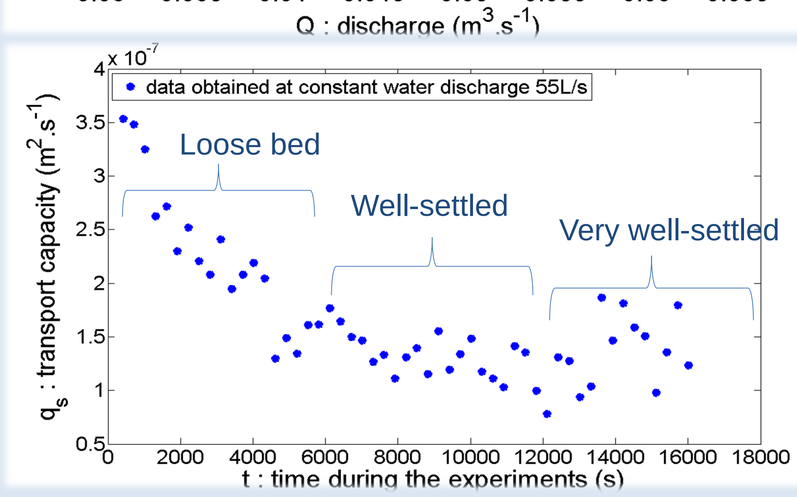
Clogged bed
Gravel+silt

Grains arrangements imbrication



Detection of grains by image processing





Critical bed shear stress τ_c:

1. Increase of the τ_c when the bed is clogged
2. Increase of the τ_c when the bed is well-settled
3. Variations in function of time at constant discharge depending on the **arrangement of the bed**
4. Stable value (settled bed)

5. Discussion

- Dependence on **methods** used to characterize the critical bed shear stress
- Importance of the **initial bed arrangement**
- Difficulties to **reproduce experiments**
- Difficulties to **quantify the experimental uncertainties**
- Description of the incipient motion with a **range of values** of critical bed shear stress?
- Difficulties to **characterize** u^*

6. References

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Wilcock, P.R., and J.B. Southard (1988), Experimental study of incipient motion in mixed-size sediment. Water Resour. Res., 24(7), 1137-1151.