



Incipient motion for bimodal mixture of gravel and silt

E. Perret, A. Herrero, Céline Berni, K. El Kadi, B. Camenen

► To cite this version:

E. Perret, A. Herrero, Céline Berni, K. El Kadi, B. Camenen. Incipient motion for bimodal mixture of gravel and silt. Workshop on modelling mixed-sediment river morphodynamics, May 2015, Delft, Netherlands. pp.1, 2015. hal-02602205

HAL Id: hal-02602205

<https://hal.inrae.fr/hal-02602205>

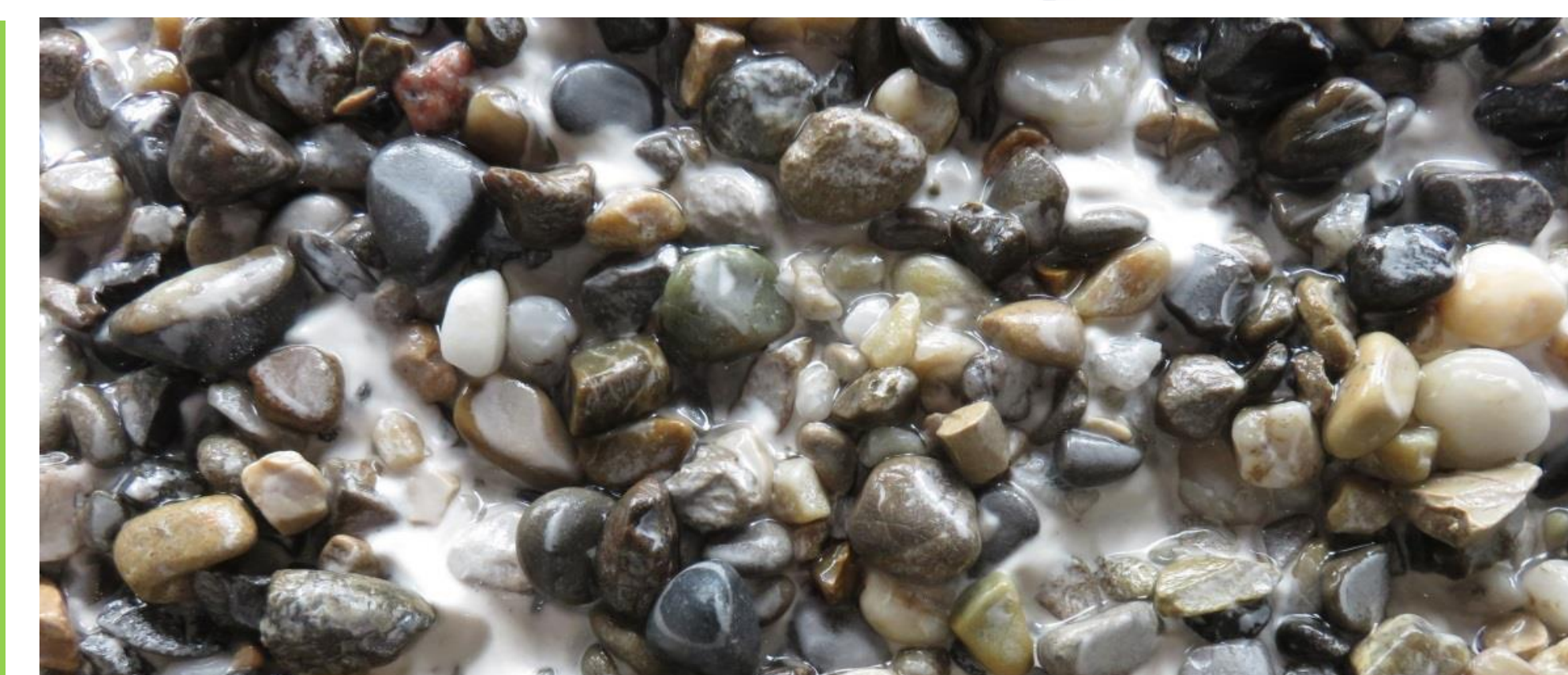
Submitted on 16 May 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Incipient motion for bimodal mixture of gravel and silt

Emeline Perret, Albert Herrero, Céline Berni,
Kamal El kadi Abderrezzak, Benoit Camenen



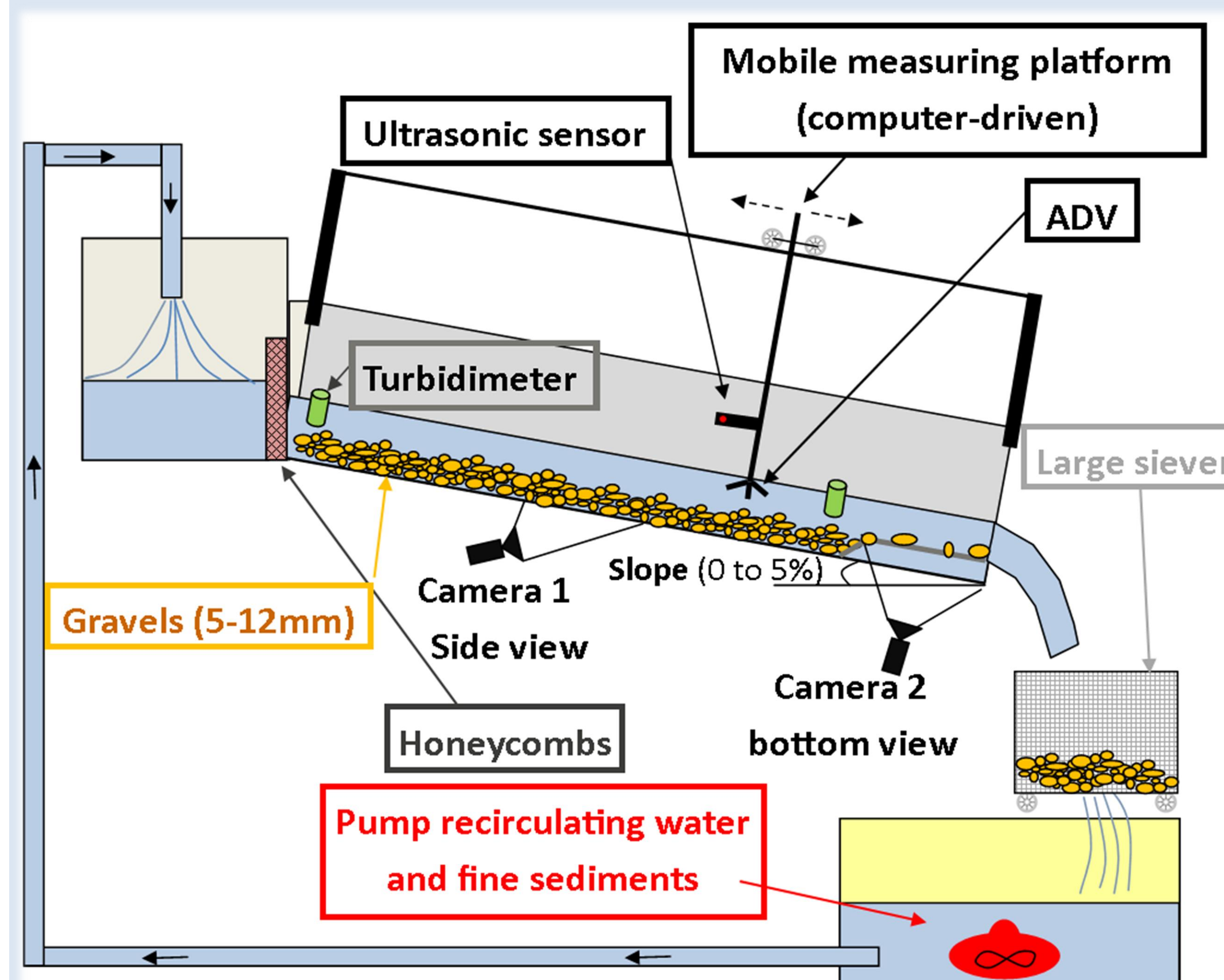
1. Context

- 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

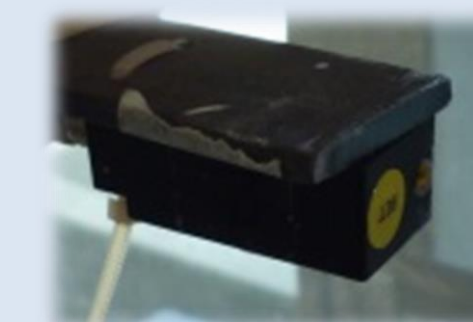
2. Experimental set-up



Measurements

1. Water depth + Bed slope

Ultrasonic sensors



2. Velocity

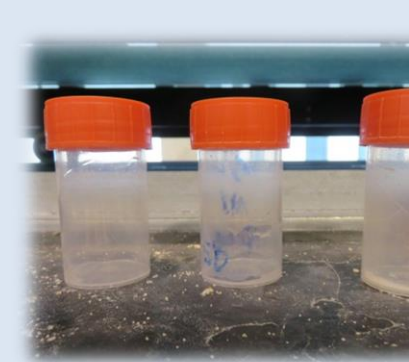
ADV



3. Fine concentration



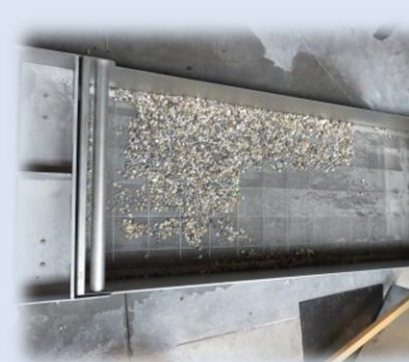
Turbidimeter



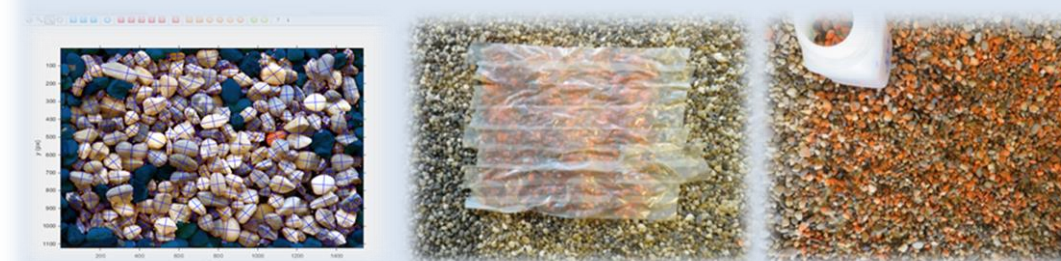
Sampling

4. Bed load samples

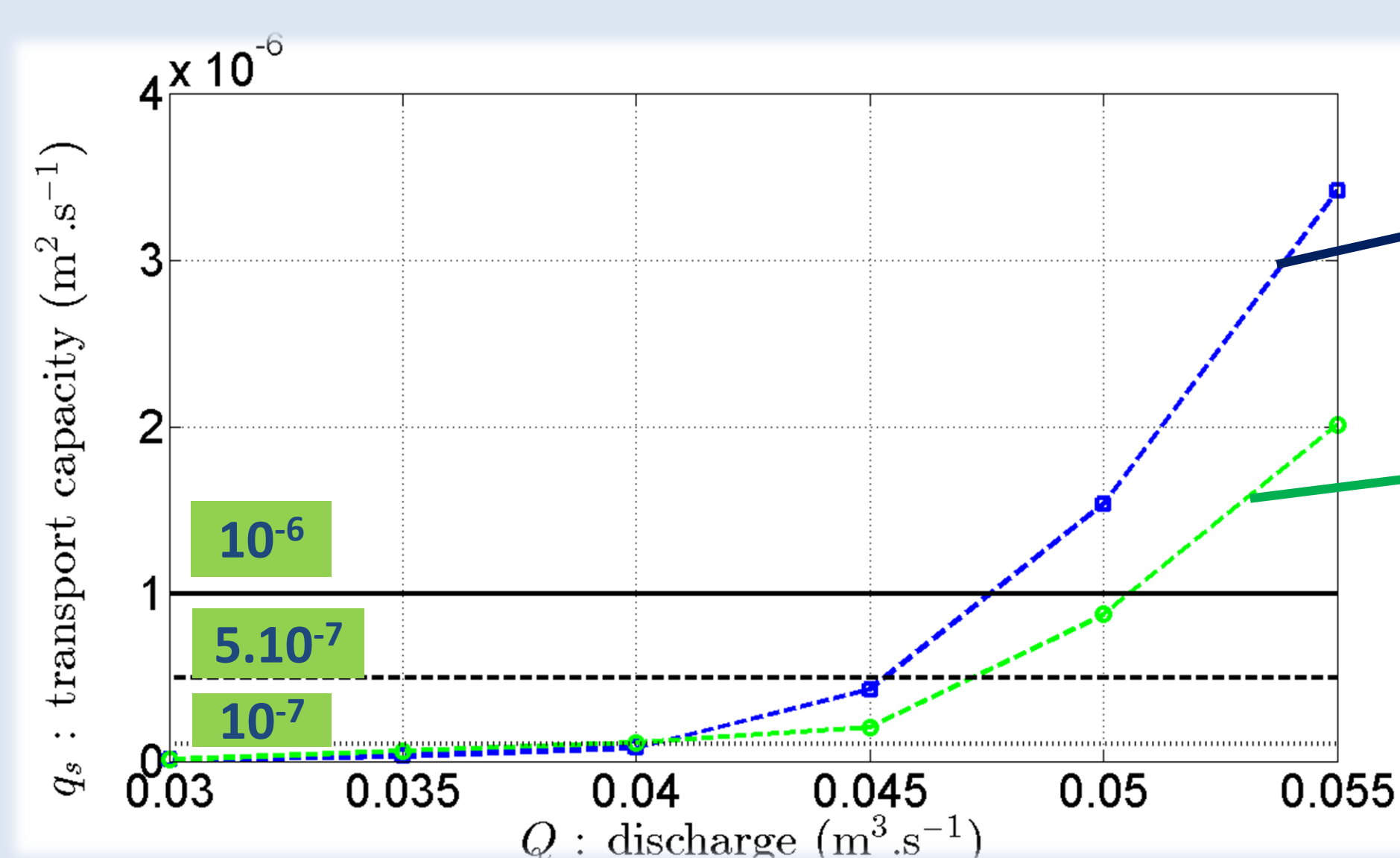
Large sieve & Image processing



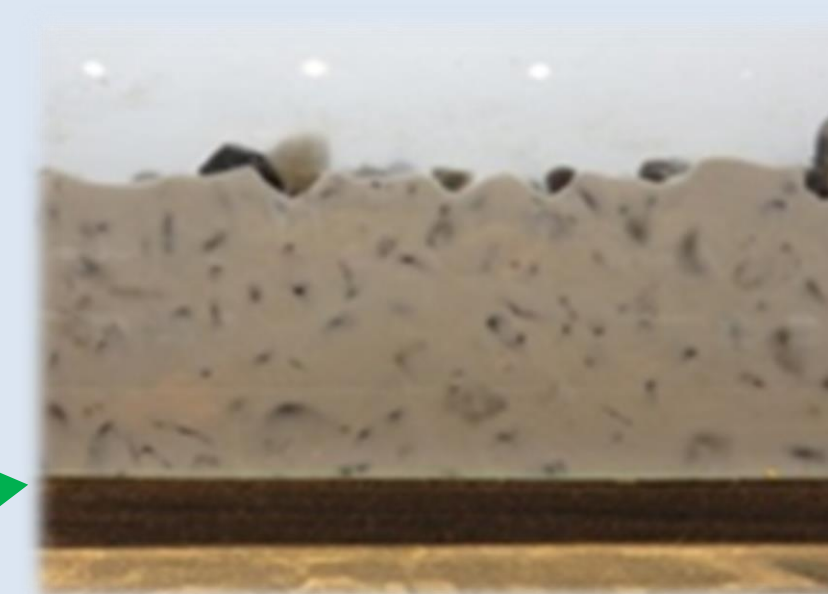
5. Bed-surface analysis (grain size distribution, roughness, topography)



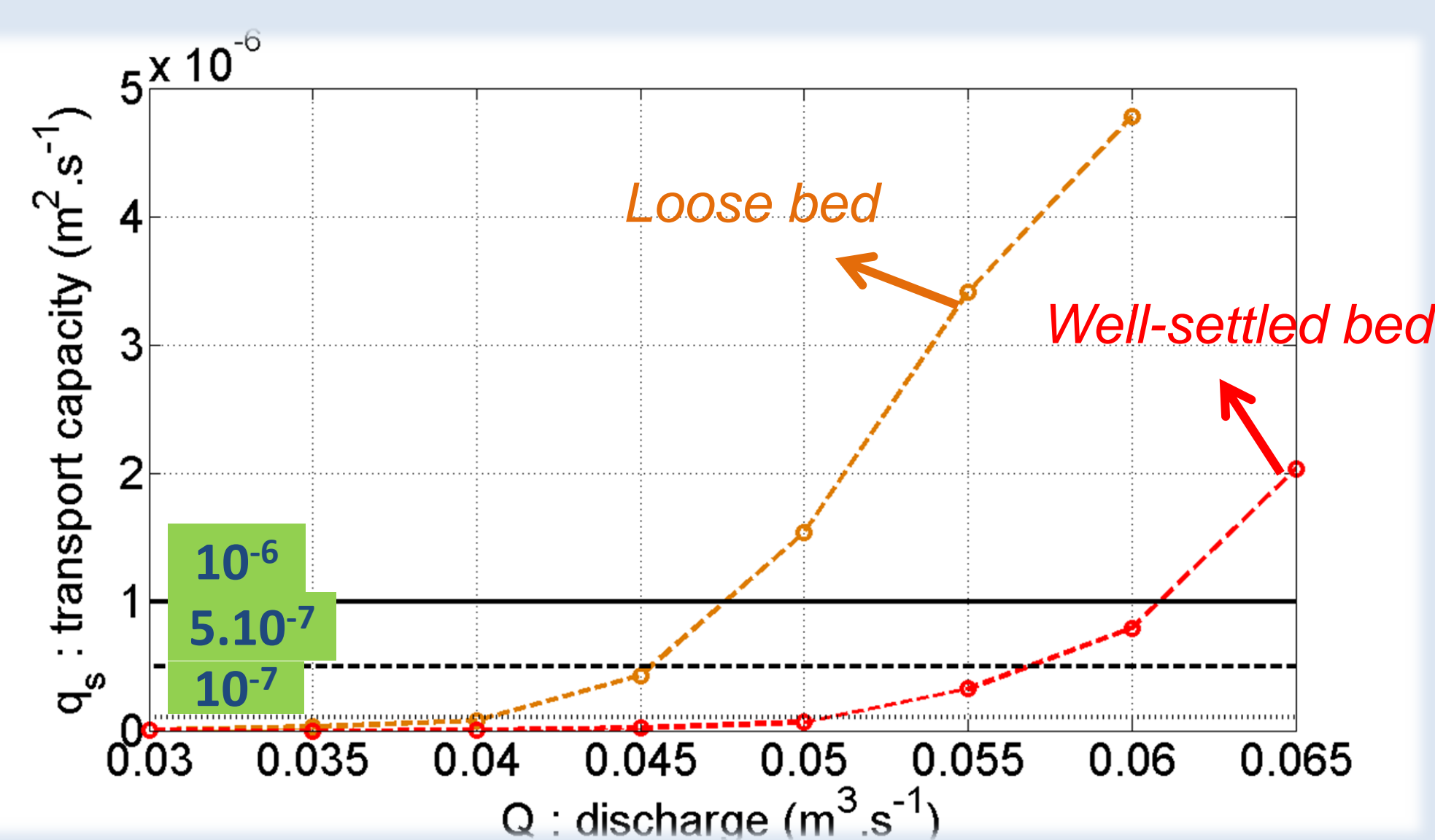
4. Results



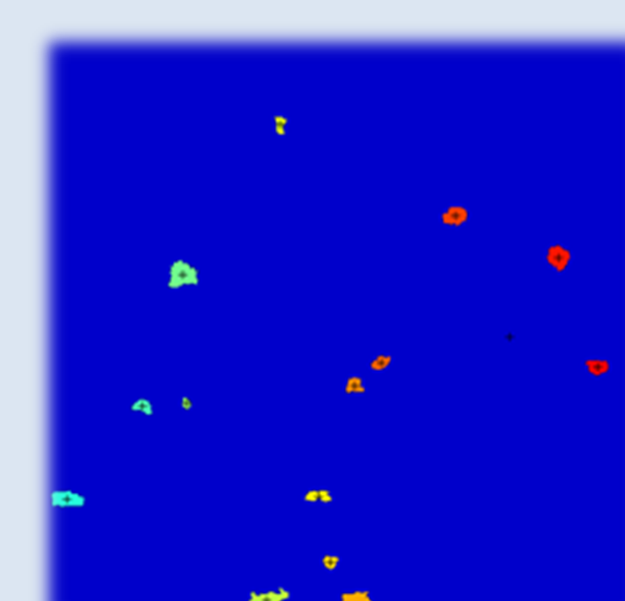
Clean bed
Gravel only



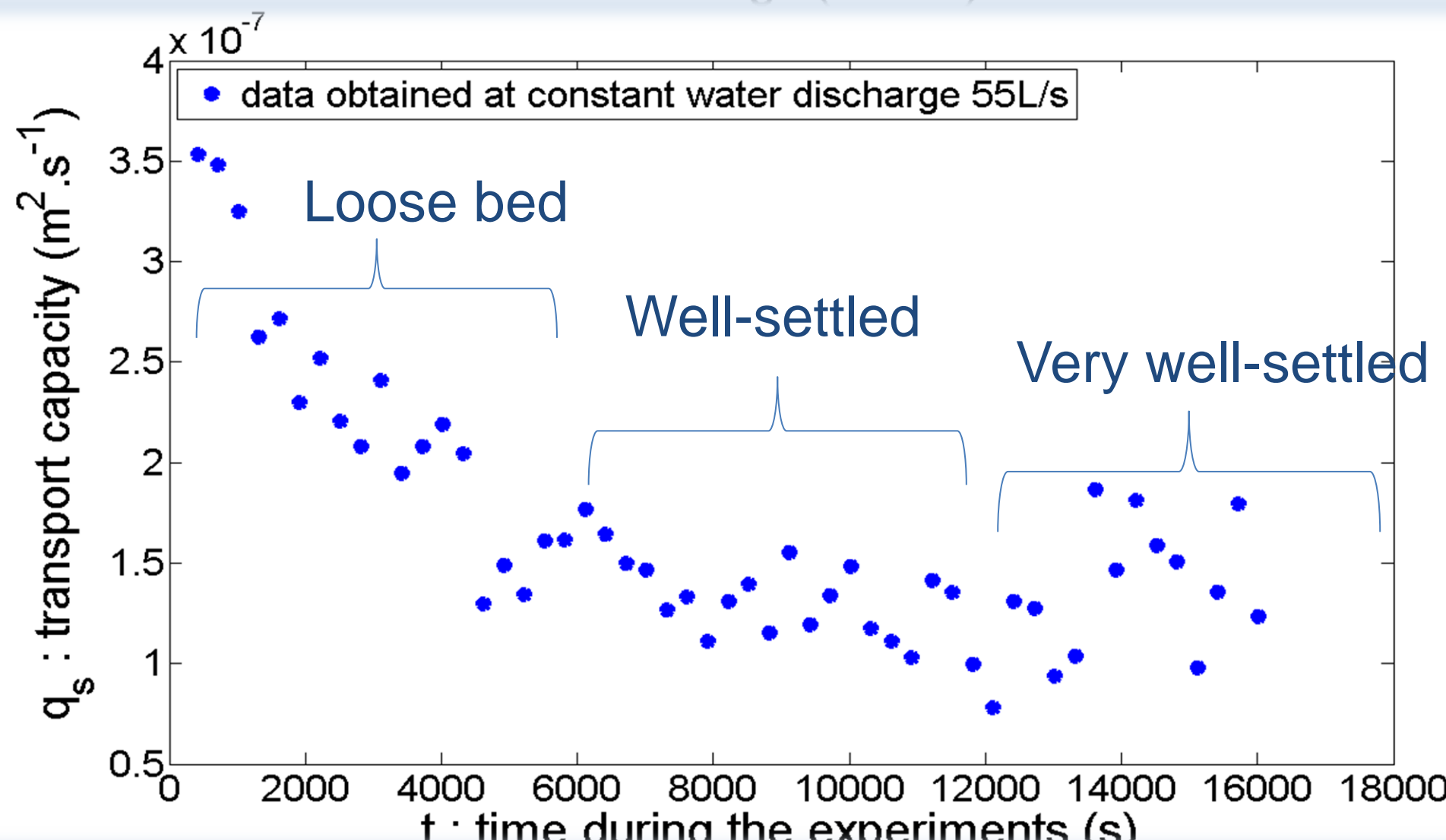
Clogged bed
Gravel+silt



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

- Buffington, J.M., and D.R. Montgomery (1997), A systematic analysis of eight decades of incipient motion studies, with special reference to gravel-bedded rivers. *Water Resour. Res.*, 33(8), 1993-2029.
- Camenen B. & Larson M. (2005). A bed-load transport formula for the nearshore, *Estuarine Coastal and Shelf Science*, 63: 249-260.
- Patel and al.(2013), Threshold for initiation of motion of unimodal and bimodal sediments. *Int. Jour. of Sed. Res.*, 28(1), 24-33
- Recking, A. (2013), A simple method for calculating reach-averaged bedload transport. *Journal of Hydraulic Engineering*, 139 (1).
- Wilcock, P.R., and J.B. Southard (1988), Experimental study of incipient motion in mixed-size sediment. *Water Resour. Res.*, 24(7), 1137-1151.