Conference Paper, Published Version

Cordier, F.; Tassi, Pablo; Claude, N.; Crosato, A.; Rodrigues, S.; Pham van Bang, D.

Influence of hiding-exposure effect and vertical sorting of sediment on bars morphodynamics

Verfügbar unter/Available at: https://hdl.handle.net/20.500.11970/104501

Vorgeschlagene Zitierweise/Suggested citation:

Standardnutzungsbedingungen/Terms of Use:

Die Dokumente in HENRY stehen unter der Creative Commons Lizenz CC BY 4.0, sofern keine abweichenden Nutzungsbedingungen getroffen wurden. Damit ist sowohl die kommerzielle Nutzung als auch das Teilen, die Weiterbearbeitung und Speicherung erlaubt. Das Verwenden und das Bearbeiten stehen unter der Bedingung der Namensnennung. Im Einzelfall kann eine restriktivere Lizenz gelten; dann gelten abweichend von den obigen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Documents in HENRY are made available under the Creative Commons License CC BY 4.0, if no other license is applicable. Under CC BY 4.0 commercial use and sharing, remixing, transforming, and building upon the material of the work is permitted. In some cases a different, more restrictive license may apply; if applicable the terms of the restrictive license will be binding.
Influence of hiding-exposure effect and vertical sorting of sediment on bars morphodynamics

F. Cordier\textsuperscript{1,2}, P. Tassi\textsuperscript{1,2}, N. Claude\textsuperscript{1}, A. Crosato\textsuperscript{2}, S. Rodrigues\textsuperscript{3}, D. Pham van Bang\textsuperscript{4}

\textsuperscript{1}EDF – R&D – LNHE, Chatou, France
\textsuperscript{2}IHE Delft and Delft University of Technology, Netherlands
\textsuperscript{3}École polytechnique de l'Université de Tours, UMR CNRS 7324 Citères, France
\textsuperscript{4}Cerema – Laboratoire Saint-Venant – ENPC, Chatou, France

florian.cordier@edf.fr

Abstract: Gravel-bed rivers inherently show a certain degree of variability in Grain Size Distribution (GSD), which strongly alters the characteristics and dynamics of alluvial bars at the macro-scale (Lanzoni, 2000b; Singh et al., 2017). However, the understanding and the modelling of the impact of sediment grading on bar morphodynamics remains limited (Siviglia and Crosato, 2016). In order to investigate the impact of grain size heterogeneity on bar morphodynamics, a set of two-dimensional fully-nonlinear morphodynamics numerical models, based on the laboratory experiments of Lanzoni (2000a,b), have been implemented in the Telemac modelling system (TMS).

Morphodynamic processes are modelled with the 2D depth-averaged hydrodynamics solver of the TMS (TELEMCAS-2D), internally coupled to the sediment transport and bed evolution module (SISYPHE). Three bedload formulas are adopted in the present study: the original formula proposed by Meyer-Peter and Müller (MPM) (1948) used for uniform sediment transport, the MPM formula modified with the hiding/exposure factor proposed Egiazaroff (1965) for modelling graded sediment transport, and the formula of Wilcock and Crowe (2003) used for the transport of graded sediment. The model is based on the active layer concept of Hirano (1971) for sediment mass continuity, with an improved algorithm for vertical sediment sorting based on the work of Reisenbüchler et al. (2016).

The numerical models simulate sediment recirculation from downstream boundary to the upstream boundary, which was used in the laboratory experiments. Two distinct laboratory experiments of alternate bar formation carried out by Lanzoni (2000a,b) are reproduced numerically, one using uniform sediment, the other one using graded (bimodal) sediment.

The results of the numerical simulations show that taking into account hiding-exposure effects is necessary to mimic the same patterns of sediment sorting as observed in the laboratory, with the accumulation of coarse sediment on the top of the bars and the presence of finer sediment in the pools. These effects appear to enhance the stability of the numerical simulations with a smoother (more realistic) topography on the bars and a more coherent spatial distribution of the different grain sizes in the riverbed. On the other hand, the results suggest that depending on the configuration of the morphodynamic system (e.g. sediment transport mode), the vertical sorting of sediment (i.e. formation of distinct sediment layers) can affect the bar properties such as amplitude, wavelength or celerity.

References:

Meyer-Peter, E. and Müller, R. (1948). Formulas for bed-load transport. In International Association for Hydraulic Structures Research. IAHR.