Geophysical Research Abstracts
Vol. 18, EGU2016-17279-2, 2016
EGU General Assembly 2016

River bed armoring in a local scour under no-supply conditions; experimental investigation and numerical model validation

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The aim of this study is to present a novel method for numerical modeling of morphological changes. The essence of the method doesn't mean the development of a new sediment transport formula, but the combined application of the existing, conditionally validated sediment transport models.
Many bedload transport formulas can be found in the literature, which were developed based on different field and laboratory measurements. Thus, the most reliability of the models usually can be expected only for the given morphological and hydrological conditions connected to the base measurements. However, commonly in the analysed cases the morphological and hydrological features are more variable both in time and in space. Therefore, the hypothesis of this study is that, complex hydromorphological processes can't be modeled by one sediment transport formula.
The authors present a solution based on laboratory experiments. Spatio-temporal developments of bed armoring, local scouring and local sediment deposition under no supply condition was monitored and analysed. The sediment transport model of Wilcock and Crowe (2003) was expected to calculate properly the local scouring and bed armoring processes, while the motion and aggradation of the finer materials were supposed to estimate reliably by the van Rijn formula (1984).
The main challenge of the combining method is to find an appropriate criterion to decide which transport formula is activated in the given space and in the given time step. The result of the investigation showed that the most reliable criteria is based on the d50 value. As soon as the d50 grain size goes below a certain value, van Rijn is activated, otherwise the Wilcock and Crowe formula calculates the sorting and armoring processes.
The results show that the combining method clearly improve the reliability of the morphological calculation. The benefit of the Wilcock and Crowe model is that it estimates quite well the sediment transport in mixed or armored channel beds. However, with this approach, the mobility of the finer material, which was eroded, was underestimated. Therefore, this formula supposed the aggradation of the finer materials right after the erosion zone. In contrast, the van Rijn formula overestimated the extent of the erosion, but do predict the transport of fine material very well. By properly combining the above mentioned approaches, the highly complex bed evolution in terms of bed changes and grain sizes distribution could be modeled.