Geophysical Research Abstracts
Vol. 18, EGU2016-11783, 2016
EGU General Assembly 2016

Modeling of replenishment of sediments on a water-worked gravel bed channel

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The presence of dams causes a sediment deficit downstream. Hence, the surface structure of the riverbeds is altered by this interruption in the sediment continuity and

The presence of dams causes a sediment deficit downstream. The surface structure of the riverbed is altered by this interruption in the sediment continuity and becoming water-worked. The main morphological effects verified in these cases are thus the generation of armored layers, bank instability, riverbed incision, changes in the channel width and coarsening of the bed particles. These results impact on the riverbed topographic variability and structure of the bedforms. Surface complexity is thus reduced with further ecological implications. The lack of fine material and surface complexity leads to the loss of aquatic and riparian habitats, limiting the possibilities for fish spawning.

Nowadays, the revitalization of disturbed river reaches forms an integral part of river management. Sediment transport and associated channel morphology are understood as key processes for recreating and maintaining aquatic ecosystems. For this purpose several replenishment techniques have been considered in order to supply sediments lacking in the downstream reaches. The replenishment techniques can be seen as a pulse-like addition of sedimentary material that initially disturbs the channel.

In this work, the response of the flow to the complementary material which is added in the channel is studied by means of the 2D shallow water equations in combination with the Exner equation. The numerical scheme is built by means of a weakly-coupled treatment between the hydrodynamic and morphodynamic equations leading to an efficient and robust solution. Computational outcomes are compared with experimental data obtained from several replenishment configurations studied in the laboratory.

The results are analyzed by means of: (i) temporal evolution of the material spreading, (ii) occupational ratio along the channel which is the area percentage that is covered by the replenishment material, (iii) travel distance of the center of the pulse mass and (iv) effect of the bed fining in the bed shear stress. The results of these experiments assist in further evaluating how water-worked gravel bed channels evolve with artificial replenishment of sediments.

This work was funded by the ITN-Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7-PEOPLE-2013-ITN under REA grant agreement n_607394-SEDITRANS. The sediment replenishment experiments were funded by FOEN (Federal Office for the Environment, Switzerland).