Geophysical Research Abstracts
Vol. 17, EGU2015-4642-1, 2015
EGU General Assembly 2015

Variations of Live-bed pier scour in steady and unsteady flow conditions

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Local scour around cylinder pier is primary subjected to live-bed condition during floods. In most instances, scour depth is effect by bed material carried by approaching flow, dune migration rate, flow intensity and vortex in front of pier as time. However most of the researches focus on the variation of local pier scour depth under clear-water conditions. This paper aims to observe temporal evolutions of pier scour in live-bed condition in order to understand nature channel pier-scour. Five groups of steady flow experiments are designed in different flow intensities varied from 1.18 to 2.21. To find out the effects of unsteady flow on scour depth, different steady flow intensities were combined as four groups of unsteady flow experiments, including: (1) advanced hydrograph, (2) delayed hydrograph, (3) symmetric hydrograph and (4) symmetric hydrograph with low peak. Unsteady flow scour depth hydrographs were verified by constant flow hydrograph in different flow intensities. The experiments were produced in a flume with 20m long, 1m wide, and a fixed slope of 0.001. All experiments were set in live-bed requirement to approach the nature condition of pier-scour during flood. A model was proposed to calculate the experiment pier- scour depth varied with time. The semi-empirical equation was used to calculate the change of scour depth obtain from experiments. Dune migration contributes to Bed load transport rate was also considered. The changing rate of scour volume based on the difference between the rate of sediment transport into the scour hole by the approach flow and that eroded from the scour hole by the vortex around the pier. Temporal evolution of pier scour can be estimated by cross-sectional area of primary vortex and the rate of change of scour volume around pier with time. The propose model gives reasonable explanation on the variations of cylinder pier-scour depth with time under unsteady flow.