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Devastating hyper-concentrated flood on the Loess Plateau, China: simulations and implications

Ga Zhang, Chenge An, and Xudong Fu

Tsinghua University, Key Laboratory of Hydrosience and Engineering, Hydraulic Engineering, Beijing, China
(zhangga18@mails.tsinghua.edu.cn)

Yellow River has long been suffered from floods and sedimentation in the history, and has brought great catastrophes to the Chinese nation. Therefore, the Yellow River is also called the “China’s sorrow”. From July 25 to 26 of 2017, most of the northern part of the Shanxi and Shannxi Province in the middle Yellow River basin encountered high intensity rainfall with the maximum rainfall of 223.6 mm. In the abstract below, we term this rainfall event as the “7.26 storm”. After the extreme rainfall, hyper-concentrated floods occurred in the Dali River and Wuding River, which are tributaries of the Yellow River. The objective of this research is to study the hyper-concentrated floods of the Wuding River (with a drainage area of 28460 km²) at hourly time-step with a numerical model. The model that we utilized is the Digital Yellow River Model (DYRIM), which a physically based spatially distributed model of watershed sediment dynamics. Due to lack of sub-daily observation data, we first calibrate and verify the model at daily time-step. Then we apply the model to simulate the 7.26 storm at hourly time-step. Results show the DYRIM could well reproduce the peak discharge, peak sediment concentration, flood timing and volume, when compared with the measured data. Furthermore, the DYRIM is able to (1) delineate spatial distribution of hillslope erosion intensity, maximum erosion intensity could reach 10000 t/km²; (2) provide information about proportion of different sources of sediment, channel erosion is the main source of the sediment to the outlet and (3) analysis the influence of check-dams on flow and sediment, the dam trapped about 40 millions tons sediment, their effect on water and sediment reduction under extreme rainfall events is limited though.