Paper Number: 1228

Research on the definition of rainfall event for the debris flow triggered by a runoff-induced mechanism

Yu, B., and Wang, Z.

State Key Laboratory of Geohazard Prevention and Geoenvironment Protection, Chengdu University of Technology, Chengdu 610059, China, 471174592@qq.com

---

Values of rainfall parameters like the cumulative rainfall, and the rainfall intensity are key factors of triggering debris flows (Yu et al. [1]). These values depend on the definition of the limits of a single continuous rainfall event. Huang [2] defined the start of a rainfall event as the moment the hourly rainfall amount is more than 4 mm, and a rainfall event ends when the rainfall intensity is less than 4 mm/h for 6 consecutive hours, or when the cumulative rainfall is less than 10 mm in 12 consecutive hours. Zhou and Tang [3] revised the definition of Huang for the Wenchuan earthquake areas (Sichuan province, China): a single continuous rainfall event starts at the moment that the hourly rainfall amount is more than 1 mm and ends when the rainfall intensity is less than 1 mm/h for 6 consecutive hours. However, these definitions may be not applicable in other areas because the definitions are based on rainfall events in Taiwan and in the Wenchuan earthquake areas.

In this paper, a series of rainfall run-off experiments were conducted on an artificial slope covered by vegetation and without vegetation. Different rain experiments were conducted, which all started with a certain amount of so called antecedent early stage rain (for pre wetting of the soil), followed by a rain period with a certain constant rain intensity. The start time for run-off was defined as the duration of rain with a certain intensity until the start of run-off (not including the early stage antecedent rain period). The start time of run-off for a certain rainfall intensity was used to determine the role of early stage rainfall. Firstly the start time of run-off without the supply of early stage rainfall (to simulate an initial dry soil moisture condition at field capacity) was set to be the standard start time for a certain rainfall intensity. Secondly the start time of run-off with different early stage rainfall amounts was recorded for the same rainfall intensity. Thirdly the standard start time was compared with the start time for a certain amount of early stage rainfall. The effect of an early stage rainfall on run-off generation can be ignored, (or this rainfall can be defined as another rainfall event) when the difference between the observed start time and the standard time was less than 5%. A new definition of a rainfall event was obtained by these experiments with early stage rainfalls and their definitions: 1) for a slope without vegetation a continuous rainfall event begins at the moment the hourly rainfall amount is more than 1 mm and ends when the rainfall intensity is less than 1 mm/h for 6 consecutive hours, or the cumulative rainfall is less than 8 mm in 12 consecutive hours; 2) for slopes with a full vegetation cover: the event starts when the rainfall amount is more than 2 mm and ends when the rainfall intensity is less than 2 mm/h for 6 consecutive hours, or the cumulative rainfall is less than 12 mm in 12 consecutive hours. The rainfall events and corresponding debris flow events in the Wenjia Gully, Sichuan, China were used to compare and test the definitions of rainfall events proposed by Huang [2], Zhou and Tang [3],

and this study. The prediction model of Yu [1] was employed to predict the debris flow occurrences using as input the rainfall events defined according to these three definitions. The results show that the use of the definition of a single rainfall event proposed in this study gives a better prediction of the occurrence of debris flows than the rainfall events defined according to Huang [2], or Zhou and Tang [3].

References:

[1] Yu B, Zhu Y, Wang T, Chen Y, Zhu Y., Tie Y., and Lu K (2014) Natural Hazards, 74: 1141-1161.

[2] Huang TH (2002) Master Dissertation, National Cheng Kung University (in Chinese with English abstract)

[3] Zhou W and Tang C (2013) Advances in Water Science 24: 786-793 (in Chinese with English abstract)