The Evolution Characteristics of Debris Flow Disaster after Wenchuan Earthquake

Guoqiang OU[1, 2], Yoshiharu ISHIKAWA[3], Huali PAN[1, 2*], Jun WANG[1, 2], Shun YANG[1, 2], Satoshi TSUCHIYA[4], Yutaka GONDA[5] and Takashi JITOUSONO[6]

[1] Key Laboratory of Mountain Surface Process and Hazards, Chinese Academy of Sciences, Chengdu, P.R China
[2] Institute of Mountain Hazards and Environment, Chinese Academy of Sciences, Chengdu, P.R China
[3] Institute of Symbiotic Science and Technology, Tokyo University of Agriculture and Technology, Japan
[4] Faculty of Agriculture, Shizuoka University, Japan
[5] Faculty of Agriculture, Niigata University, Japan
[6] Department of Biological Sciences, Faculty of Agriculture, Kagoshima University
* Corrispongding author: E-mail: hlpan@imde.ac.cn

INTRODUCTION

Most of the Wenchuan earthquake affected areas had no debris flow before the earthquake, but abundant loose deposits induced by the earthquake have served as the source materials for debris flows, resulting in a dramatic increase of debris flow occurrences after the earthquake (2008-2014). Therefore, most of the earthquake affected areas have few rainfall and hazards data before. Moreover, a huge amount of loose deposits are present in the channels and slopes, causing dramatic changes on the environmental development for the occurrence of debris flow. The study of rainfall threshold has become more complex, and the traditional methods cannot satisfy the need for debris flow early warning and mitigation in these areas.

METHODOLOGY

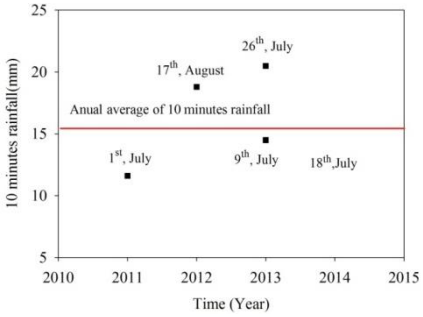
Guojuanyan gully, one of the tributaries of Shenxi Gully in Du Jiangyan city, located in the meizoseismal areas of the Wenchuan earthquake, was selected as the study area. After the Wenchuan earthquake, continuous field surveillance was undertaken and a debris flow monitoring system was also established in this gully. To identify the debris flow events, this monitoring system recorded stream water depth, precipitation and real-time video of the channel. The monitoring data are synchronous and these real-time data do not need to be digitized. When an abnormal rainfall or a debris flow event occurs, the real-time data, including rainfall data, video record, and water depth data, can be observed and queried directly in the remote client computer located at the Institute of Mountain Hazards and Environment, Chinese Academy of Sciences. As such, these data can be used to analyze the rainfall or other characteristics, such as the 10-min, 1-and 24-h critical rainfall. The recorded video is usually used to analysis the whole inundated process of debris flow events and to identify debris flow events as well as the data from rainfall, flow depth, and field investigation.

RESULTS

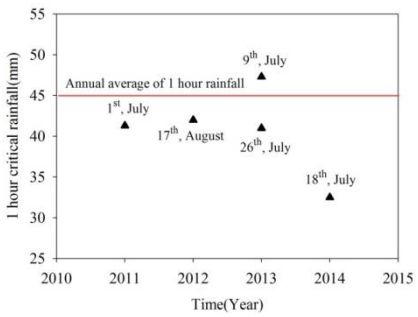
Based on the rainfall characteristics, the rainfall patterns and three kinds of critical rainfall were analyzed (**Fig. 1**). Finally, according to the initiation mechanism of hydraulic-driven debris flow, combined with the runoff yield and concentration laws of the watershed, this study promoted a new method to calculate the debris flow rainfall threshold (**Fig. 2**). And it was validated that this method can be applied to debris flow early warning and mitigation in data-lacking areas.

CONCLUSION

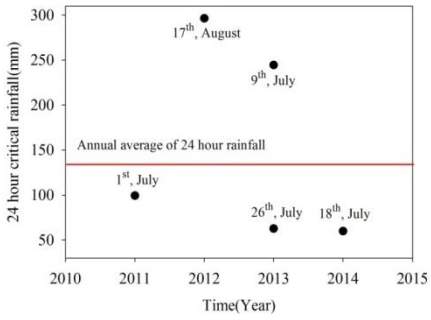
This paper presents the characteristics of debris flow after Wenchuan earthquake. The rainfall characteristics, including the rainfall pattern and three kinds of critical rainfall were fully explored, and the debris flow rainfall threshold in the study site was promoted.



(a) The 10-minute critical rainfall



(b) The 1-hour critical rainfall



(c) The 24-hour critical rainfall

Fig. 1 The critical rainfall of debris flows in the Guojuanyan gully

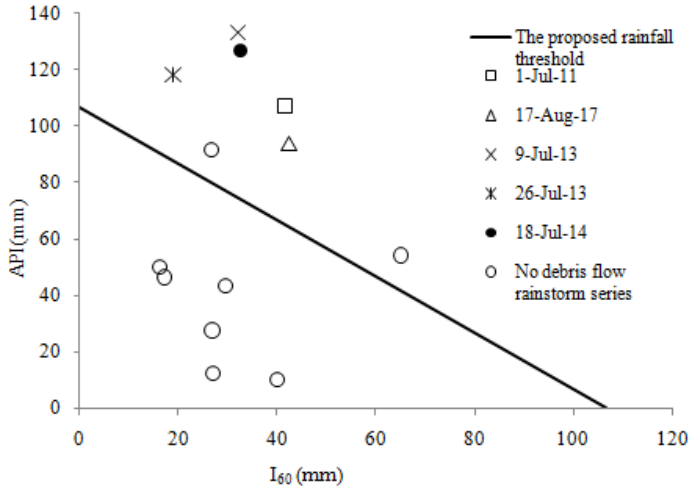


Fig. 2 The proposed rainfall threshold curve of debris flows in the Guojuanyan gully

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Keywords: Rainfall characteristics; Rainfall threshold; Evolution laws; Debris flow-prone environment; Wenchuan earthquake