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Temporal characteristics of debris flow surges

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Abstract: Debris flow is one of the most destructive geomorphological events in mountainous watersheds, which usually appears in form of successive surge waves as observed all over the world. In particular, debris flows in the Jiangjia Gully (JJG) in southwest China have displayed a great variety of surge phenomena; each debris flow event contains tens or hundreds of separate surges originating from different sources. Therefore, the surge sequence of an event must encode the information of debris flow developing. The UAV (unmanned aerial vehicle) photos provide an overview of debris-flow sources, showing the different potential of debris flow; and surge sequences present various patterns responding to the rainfall events. Then the variety of rainfalls and material sources determine the diversity of surge sequence. Using time series analysis to the surge discharge sequences, we calculate the Hurst exponent, the autocorrelation function, and the power spectrum exponent, and find that all the sequences commonly share the property of long-term memory and these parameters are correlated in exponential form, with values depending on rainfall patterns. Moreover, all events show a gross trend of discharge decay, despite the local rainfall process, which implies the intrinsic nature of the surge sequence as a systematic behavior of watershed. It is expected that these findings are heuristic for establishing mechanisms of debris flow initiation and evolution in a watershed.