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Evaluation of effective energy for splash and sheet erosion on post-fire steep hillslopes

Seung Sook Shin (1), Sang Deog Park (2), and Yoonhee Hwang (3)

(1) Research Center for River Flow Impingement and Debris Flow, Gangneung-Wonju National University, Gangneung, Republic of Korea (cewsook@hanmail.net), (2) Department of Civil Engineering, Gangneung-Wonju National University, Gangneung, Republic of Korea (sdpark@gwnu.ac.kr), (3) Department of Civil Engineering, Gangneung-Wonju National University, Gangneung, Republic of Korea (bay_yh@naver.com)

The interrill erosion by raindrop and surface runoff is not separated definitely due to the synchronous interaction of raindrop splash and sheet flow transport. On post-fire steep hillslopes of a various vegetation recovery the interaction is more complex.
In this study the effective energies of rainfall and surface runoff were introduced to evaluate the contributions for splash and sheet erosion. The effective kinetic energy of rainfall inducing splash erosion was determined by horizontal component of slope for rainfall kinetic energy deducting energies dissipated by structure of vegetation canopies and a litter layer. The effective potential energy of surface runoff transporting soil particles was derived from potential energy of the available surface water following rain-mass allocations of interception and infiltration. The effective energy for splash and sheet erosion was defined as the sum of the effective kinetic energy of rainfall and effective potential energy of surface runoff. The data observed from experimental plots on steep hillslopes were used to evaluate the effective energies for interrill erosion. While sediment yield on densely vegetated slopes depended greatly on effective kinetic energy, they from hillslopes having sparse coverage were dominated by effective potential energy. The energy dissipated by soil erosion showed the highest correlation coefficient with the effective energy under various cover conditions. The kinetic energy of raindrops was greatly reduced by the litter layer and the potential energy of rainwater decreased predominantly due to infiltration. Effective kinetic energies were generally lower than effective potential energies. The average proportions of effective potential energy to total effective energy were respectively 68.7%, 43.1%, and 49.1% for the plots with low, middle, and high vegetation coverage. The energy efficiency for interrill erosion decreased with increasing vegetation coverage and showed high value under low vegetation coverage in heavy rainfall. The results indicate that the effective energy is physically useful factor to evaluate the interrill erosion occurred by the complicated interaction of rain splash and sheet flow on post-fire steep hillslopes.

Keywords: Splash erosion; Sheet erosion; Effective kinetic energy; Effective potential energy; Steep hillslope

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