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SUMMARY OF DOCTORAL THESIS

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Title: Modeling of Interrill Sediment Generation and Soil Microtopography Dynamics under Variable Simulated Rainfall Erosivity
(降雨侵食による微地形動態とインターリル土壌堆積のモデル化)

Deformation of soil surface due to raindrop impact involve several processes have not yet been well understood. This study was attempted to measure, evaluate, and model two important processes: (1) soil microtopography change and (2) soil particle detachment due to raindrop impact. In order to understand these processes, robust techniques must be used to quantify each factor affects these processes.

Firstly, the potential use of a piezoelectric transducer to measure the rainfall impact energy under simulated rainfall conditions was investigated. The simulated rainfall kinetic energy (*KE*) and drop size distribution were measured using piezoelectric transducers, modified from the Vaisala RAINCAP® rainfall sensor. The direct measurement of the kinetic energy was significantly correlated with the estimated kinetic energy using the drop size distribution data and empirical fall velocity relationships (r > 0.84, P=0.005). The effect of the rainfall characteristics produced by dripper-type rainfall simulator on splash soil erosion (D_s) was also assessed. The relationship between the rainfall intensity (I) and *KE* was found to be different from natural rainfall and the I-D_s relationship followed the same trend. This result emphasizes the importance of the *I-KE* relationship in determination of the I-D_s relationship, which can differ from one rainfall simulator to another. Accordingly, to improve the soil splash estimation by simulated rainfall the characteristics of the simulated rainfall have to be taken into account.

Secondly, the potential of using consumer-grade cameras and close-range photogrammetry procedures to quantify soil microtopography at plot-scale level ($\leq$ 1 m^2) were assessed using simulated soil surface. The surfaces' digital elevation model (*DEM*) was generated using the photogrammetry system (*PHM*) involving a consumer-grade camera, and pin-microrelief meter (*PM*). The *DEM* generated using the *PHM* was assessed for accuracy, roughness indices, depression area percentage, depression storage capacity, and micro-rills delineation in comparison with the *PM*. A consumer-grade camera and close-range photogrammetry had high potential to quantify the soil microtopography. The method was also assessed to quantify the soil microtopography changes during rainfall. A reference surface rectification method was developed to detect and eliminate the *DEM* errors prior to interpolation. The second was the parametric statistical method, which was used to detect and rectify the *DEM* errors after interpolation. The automated digital photogrammetric system with the rectification methods accurately generated three dimensional visions of the soil microtopography during rainfall.

Thirdly, two modeling approaches, empirical and physically-based, were assessed to evaluate the capability of each approach to estimate the sediment yield under hillslope condition. The empirical models tested in this study used a combination of factors, which influence the sediment yield, rainfall intensity, slope and runoff. The physically-based model used the kinematic wave method to estimate runoff and the sediment mass balance equation to estimate the sediment yield. A comparison between the empirical models and the physically-based model showed that the physically-based model, which uses soil bulk density and hydraulic conductivity, estimates the sediment yield and runoff effectively.