EGU24-14123, updated on 25 Jan 2025
https://doi.org/10.5194/egusphere-egu24-14123
EGU General Assembly 2024


# Improved interrill erosion prediction by considering the impact of the near-surface

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The mechanism of the interrill erosion process is still unclear under complex conditions. Spatio-temporal variations of the near-surface hydraulic gradient are a common occurrence; however, few attempts have been made to characterize the near-surface hydraulic gradient for erosion prediction. Therefore, the objective of this study is to determine the influence of exogenic erosional forces (rainfall, overland flow, and seepage) on interrill erosion processes by considering the impact of the near-surface hydraulic gradient. Five near-surface hydraulic gradients (70% of field capacity, field capacity, saturated, artesian seepage at 20 cm and 40 cm of the hydrostatic pressure head) were applied in clay loam soil at two representative slope gradients of 8.75% and 17.63% under three rainfall intensities of 30, 60, and 90 mm $h^{-1}$. The results showed that the near-surface hydraulic gradient was the dominant factor in the interrill erosion process in addition to rainfall intensity ($I$), runoff ($Q$), and slope gradient ($S$). There was a significant improvement in the prediction accuracy of the interrill erosion rate when the factor of near-surface hydraulic gradient was introduced into the interrill erosion prediction equation based on the Water Erosion Prediction Project (WEPP) concept. The $R^2$ and $NSE$ values were 22.36% to 210.00% higher than those of existing empirical equations (main parameters: $I$, $I$&$S$, $I$&$Q$, $I$&$S$&$Q$). The correlation matrix results indicated that the flow velocity was a key hydraulic parameter for predicting the interrill erosion rate. The interrill erosion rate was predicted well by a simple power function of the flow velocity, although this relationship lacks clear physical meaning. We also found that the interrill erosion rate increased as a power function with the runoff depth, rainfall intensity, hydrostatic pressure head and slope gradient. Considering the integrated effect of the exogenic erosional dynamics on the interrill erosion, a power function that included the physical description of the hydrodynamic parameters, rainfall intensity and hydrostatic pressure head was used to predict the interrill erosion rate. The results of this research provide new insights into developing process-based and mechanistic models for interrill erosion processes.