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A comparison of runoff and erosion patterns in different climate zones of China

Qihua Ke and Keli Zhang
Beijing Normal University, School of Geography, Faculty of Geographical Science, Beijing, China (qhke@mail.bnu.edu.cn)

The USLE is the most successful model used to predict soil loss worldwide. However, many studies have shown that there will be some inaccuracy inevitably when USLE is applied outside the Eastern USA and the parameters must be revised with local data owing to the interactions among erosive factors such as climate and soil act in different way under different conditions. To improve the accuracy of the model, it is necessary to explore the patterns of runoff and sediment under different soil conditions in different climate zones. China is such a vast area with various climate and soil conditions, in which erosion processes is complex and diverse. In this study, we selected 7 runoff plots which spread across 6 water erosion areas and distribute throughout 5 temperature zones. We first screened 3-8 years data of the 7 plots that locate in Heshan with black-soil, Ansai with loessal-soil, Miyun with skeleton-cinnamon-soil, Yuexi with yellow-brown-soil, Suining with purple-soil, Bijie with yellow-soil and Anxi with red-soil. Then the influences of the rainfall and topography factors were eliminated via standardization process, i.e. to obtain overland runoff and erosion amount generated by unit rainfall erosivity under the slope length 20m and slope gradient 15° case. The results show that:
(1) There are significant differences in the overland runoff patterns among different soil slopes in different climate zones, as well as the erosion patterns. As the temperature zone shifts from North to South, both runoff depth and erosion modulus appears a general trend of decrease first and then increase. Notwithstanding, the variations degree of runoff and erosion are distinct among different soil type, i.e. the matching degree of runoff and erosion patterns is not the same for all soils. The matching degree can be divided into 3 types: a). Well-matched type for medium soils; b). Bad-matched type for coarser soils; c). Mismatched type for finer soils.
(2) With the increase of erosive agents such as rainfall erosivity and overland runoff, the runoff or erosion generated by unit erosive agent can make a significant difference after a critical point on purple-soil, karst yellow-soil and black soils. Besides, the change trend of all 3 relationships are the same up for black-soil and purple-soil but down for red-soil, in which similar critical erosivity for black soils and purple-soil.
(3) Extreme rainfall events happen frequently in Southern Red Soil Region, which happens during April-August in Yuexi and June-October in Anxi, and just a few cases for Ansai, Miyun, Suining and Bijie during June-August, but little case for Heshan in Northeast Black Soil Region. The contribution of extreme rainfall to annual runoff and erosion shows a similar rough trend as standardizd runoff and erosion varying as the temperature zone shifts from North to South, i.e. decreases first and then increases.
There are interactions between climate and soil on the slope process and its effect on runoff and erosion patterns in different climate zones merits future research.