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A storm-based CSLE incorporating the modified SCS-CN method for soil loss prediction on the Chinese Loess Plateau

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The Chinese Loess Plateau is one of the most erodible areas in the world. In order to reduce soil and water losses, suitable conservation practices need to be designed. For this purpose, there is an increasing demand for an appropriate model that can accurately predict storm-based surface runoff and soil losses on the Loess Plateau. The Chinese Soil Loss Equation (CSLE) has been widely used in this region to assess soil losses from different land use types. However, the CSLE was intended only to predict the mean annual gross soil loss. In this study, a CSLE was proposed that would be storm-based and that introduced a new rainfall-runoff erosivity factor. A dataset was compiled that comprised measurements of soil losses during individual storms from three runoff-erosion plots in each of three different watersheds in the gully region of the Plateau for 3–7 years in three different time periods (1956-1959; 1973-1980; 2010-13). The accuracy of the soil loss predictions made by the new storm-based CSLE was determined using the data for the six plots in two of the watersheds measured during 165 storm-runoff events. The performance of the storm-based CSLE was further compared with the performance of the storm-based Revised Universal Soil Loss Equation (RUSLE) for the same six plots. During the calibration (83 storms) and validation (82 storms) of the storm-based CSLE, the model efficiency, E, was 87.7% and 88.9%, respectively, while the root mean square error (RMSE) was 2.7 and 2.3 t ha-1 indicating a high degree of accuracy. Furthermore, the storm-based CSLE performed better than the storm-based RULSE (E: 75.8% and 70.3%; RMSE: 3.8 and 3.7 t ha-1, for the calibration and validation storms, respectively). The storm-based CSLE was then used to predict the soil losses from the three experimental plots in the third watershed. For these predictions, the model parameter values, previously determined by the calibration based on the data from the initial six plots, were used in the storm-based CSLE. In addition, the surface runoff used by the storm-based CSLE was either obtained from measurements or from the values predicted by the modified Soil Conservation Service Curve Number (SCS-CN) method. When using the measured runoff, the storm-based CSLE had an E of 76.6%, whereas the use of the predicted runoff gave an E of 76.4%. The high E values indicated that the storm-based CSLE incorporating the modified SCS-CN method could accurately predict storm-event-based soil losses resulting from both sheet and rill erosion at the field scale on the Chinese Loess Plateau. This approach could be applicable to other areas of the world once the model parameters have been suitably calibrated.